PASSAIC RIVER BASIN
ROCKAWAY RIVER, MORRIS COUNTY
MORRIS COUNTY
NEW JERSEY

LEVEL II

(15) DACW61-77-C-0012

ROCK RIDGE LAKE DAM

NJ 00178

(9) Final rept. | (10) Warren A. Guiney

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

(6) National Dam Safety Program. Rock Ridge Lake Dam (NJ ØØ178), Passaic River Basin, Rockaway River, Morris County, Morris County, New Jersey. Phase 1 Inspection Report.

(11) 1979

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

1979

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00178	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Phase I Inspection Report National Dam Safety Program Rock Ridge Lake Dam Morris County, N.J		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Guinan, Warren A., P.E.		8. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS Anderson-Nichols 6 Louden Rd. Concord, NH 03301		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106		12. REPORT DATE August, 1979 13. NUMBER OF PAGES 50
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

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17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Dams
Spillways
Structural Analysis
Safety
Visual inspection
National Dam Inspection Act Report

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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IN REPLY REFER TO

NAPEN-D

17 SEP 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Rock Ridge Lake Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Rock Ridge Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure, as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 20 percent of the Probable Maximum Flood--PMF - would overtop the dam. The spillway is considered "inadequate" instead of "seriously inadequate" because dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstrem from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, the owner should retain the services of a professional engineer qualified in the design and inspection of dams to accomplish the following:

(1) Design and oversee procedures for removing trees and brush from the upstream slope, downstream slope and downstream toe area of the dam.

(2) Investigate the large soft wet area near the west abutment and design appropriate remedial measures.

(3) Inspect the downstream slope and toe of the dam after the trees, brush, and debris have been removed.

(4) Design and supervise repairs for the eroded areas on the upstream slope at the spillway training walls and at two locations between the spillway and the west abutment.

(5) Design repairs to the concrete spillway apron and areas of spalling and erosion on the weir and training wall.

(6) Provide a paved surface for the walkway on the dam crest.

(7) Establish grassy vegetation or other protective covering on the cleared slopes and remaining portions of the crest of the dam.

(8) Investigate the need to install an upstream valve on the low level outlet pipe to relieve constant pressure in the pipe in the embankment as it presently exists.

c. Within 30 days from the date of approval of this report, the owner should carry out the following remedial measures:

(1) Remove the raft floating against the upstream edge at the spillway crest.

(2) Check the condition of the dam periodically and monitor the seepage at the wet areas at the downstream toe until remedial measures are effected.

d. Within six months from the date of approval of this report, the owner should carry out the following additional remedial measures:

(1) Remove the two trees that have fallen into the discharge channel.

(2) Clear trees and brush on either side of the discharge channel.

(3) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure.

NAPEN-D
Honorable Brendan T. Byrne

(4) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years.

(5) Periodically operate the low level outlet valve to prevent silting and seizing by rust.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

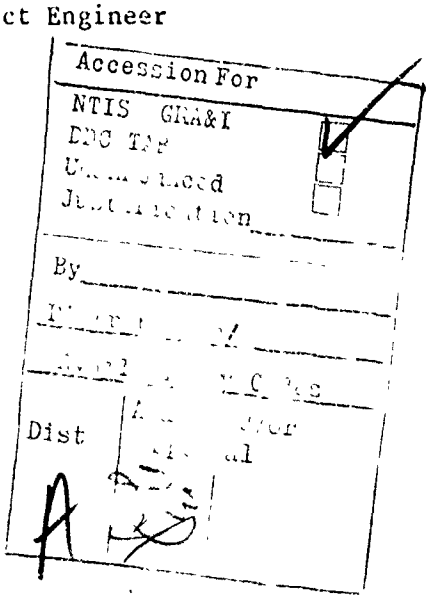
Sincerely,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625



ROCK RIDGE LAKE DAM (NJ00178)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 17 May 1979 by Anderson-Nichols and Company, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Rock Ridge Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure, as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 20 percent of the Probable Maximum Flood--PMF - would overtop the dam. The spillway is considered "inadequate" instead of "seriously inadequate" because dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstrem from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, the owner should retain the services of a professional engineer qualified in the design and inspection of dams to accomplish the following:

(1) Design and oversee procedures for removing trees and brush from the upstream slope, downstream slope and downstream toe area of the dam.

(2) Investigate the large soft wet area near the west abutment and design appropriate remedial measures.

(3) Inspect the downstream slope and toe of the dam after the trees, brush, and debris have been removed.

(4) Design and supervise repairs for the eroded areas on the upstream slope at the spillway training walls and at two locations between the spillway and the west abutment.

(5) Design repairs to the concrete spillway apron and areas of spalling and erosion on the weir and training wall.

(6) Provide a paved surface for the walkway on the dam crest.

(7) Establish grassy vegetation or other protective covering on the cleared slopes and remaining portions of the crest of the dam.

(8) Investigate the need to install an upstream valve on the low level outlet pipe to relieve constant pressure in the pipe in the embankment as it presently exists.

c. Within 30 days from the date of approval of this report, the owner should carry out the following remedial measures:

(1) Remove the raft floating against the upstream edge at the spillway crest.

(2) Check the condition of the dam periodically and monitor the seepage at the wet areas at the downstream toe until remedial measures are effected.

d. Within six months from the date of approval of this report, the owner should carry out the following additional remedial measures:

(1) Remove the two trees that have fallen into the discharge channel.

(2) Clear trees and brush on either side of the discharge channel.

(3) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure.

(4) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years.

(5) Periodically operate the low level outlet valve to prevent silting and seizing by rust.

APPROVED: _____

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 1 September 79

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Rock Ridge Lake Dam
ID Number:	Fed. ID No. NJ00178
State Located:	New Jersey
County Located:	Morris
Stream:	Denney Brook
River Basin:	Passaic
Date of Inspection:	May 17, 1979

ASSESSMENT OF GENERAL CONDITIONS

Rock Ridge Lake Dam is about 53 years old and in fair overall condition. It is small in size and is classified as Significant Hazard. The crest of the dam shows evidence of trespassing and is bare of vegetation. Large trees and brush are growing on the upstream and downstream slopes of the dam. Extensive erosion has occurred to the upstream slope next to the training walls on both sides of the concrete spillway, and in two locations on the right crest of the dam. A large soft wet area was observed at the downstream toe near the right abutment. Debris has been dumped on the downstream slope near the right abutment. The concrete spillway apron has an open and unsealed expansion joint. Erosion and spalling of the surface of the spillway is visible. Several drill holes have been made in the top surface of the spillway apron. The spillway can pass approximately 20 percent of the PMF and is inadequate.

It is recommended that the owner retain the services of a professional engineer, qualified in the design and construction of dams, to accomplish the following in the near future: remove trees, their root systems and brush from the upstream slope, downstream slope, and downstream toe area of the dam; investigate the soft wet area near the right abutment of the dam and design and implement appropriate remedial measures; inspect the downstream slope and toe of the dam after the trees, brush, and debris have been removed; design and implement repairs for the eroded areas on the upstream slope at the spillway training walls and westerly embankment; conduct a more detailed hydrologic and hydraulic analysis of the watershed, dam,and spillway,and design and implement appropriate

mitigating measures to provide adequate discharge capacity; repair the drill holes, eroded and spalled areas in the apron, weir, and spillway concrete; provide a paved surface for the walkway on the dam crest; establish grassy vegetation or other protective covering on the cleared slopes and remaining portions of the crest of the dam; and investigate the need to install an upstream valve on the low level outlet pipe to relieve constant pressure in the pipe in the embankment as it presently exists.

It is further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures: immediately, remove the raft floating against the upstream edge of the spillway crest; starting immediately, check the condition of the dam periodically until remedial measures are effected; starting soon, clear trees from the banks of the discharge channel and remove the two trees that have already fallen; in the near future, establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of flood-flow conditions or imminent dam failure. In addition, the owner should engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years. This should be started in the near future. Starting soon, the low level outlet valve should be operated periodically to prevent silting and seizing by rust.

Warren A. Guinan

Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848

17 MAY 1979

OVERVIEW

ROCK RIDGE LAKE DAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY REPORT

ROCK RIDGE LAKE DAM N.J. NO. 440 FED ID NO. NJ00178

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
ROCK RIDGE LAKE DAM
U.S. #NJ00178 N.J. #440

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Rock Ridge Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water REsources by letter dated 4 April 1979 under Contract No. FPM-39 dated 28 June 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 17 May 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Rock Ridge Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Rock Ridge Lake Dam is a 10-foot high, 235-foot long earthfill dam, built around 1926 and rebuilt in 1949. The downstream and upstream faces have 3H:1V slopes. The 40-foot long free overflow spillway is near the center of the dam. The crest of the spillway is capped by a concrete slab. Immediately downstream of the crest is a sloping spillway apron about 42 feet long. A 12-inch diameter concrete, low level outlet pipe is located left of center of the spillway and one foot above the downstream toe. The 2.5' x 2.9' valve box, located in the center of the spillway apron just downstream of the 1-foot pier of the service bridge, contains one 12-inch gate valve. The service bridge is constructed of steel beams with wooden deck and railing and is set on one concrete pier. It spans the spillway about one foot upstream of the spillway crest and about 1.8 feet above the crest. A dirt path extends along the dam crest from each end of the service bridge. Essential features of the dam are given in Figure 2.

b. Location. The dam is located in Morris County, New Jersey on Denney Brook, a tributary to the Rockaway River, approximately 1 mile northwest of Denville. It is at north latitude 40°54.6' and west longitude 74° 27.9'. A location map is given in Figure 1.

c. Size Classification. Rock Ridge Lake Dam is classified as being "small" on the basis of storage at the dam crest of 174 acre-feet, which is less than 1000 acre-feet, but more than 50 acre-feet, and on the basis of its height of 10.2 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the downstream area and the breach analysis contained herein show that failure of Rock Ridge Lake Dam could possibly lead to the overtopping of Denney Pond Dam downstream and subsequent overtopping of Florence Avenue, leading to appreciable but not excessive damage to 2 houses just downstream of Florence Avenue. Loss of any lives is unlikely. Thus Rock Ridge Lake Dam is classified as Significant Hazard.

e. Ownership. The dam is owned by the Rock Ridge Community Club, Denville, New Jersey. The President, Kenneth McQueen, 31 Edgewater Drive, Denville, New Jersey, was contacted for information.

f. Purpose of Dam. The lake was originally designed and is currently used for recreational purposes.

g. Design and Construction History. Little information was disclosed regarding the original design and construction of the dam, which took place around 1926. The dam was repaired and spillway rebuilt in 1949 after a cloudburst caused failure of the dam in 1947. Plans are on file at New Jersey Department of Environmental Protection. Little information was disclosed regarding the reconstruction.

h. Normal Operational Procedures. Rock Ridge Lake Dam is operated for recreational purposes. The lake level is lowered every 2 to 3 years to repair docks.

1.3 Pertinent Data

a. Drainage Areas

Drainage Area - .87 square miles (See Appendix 4.)

Normal Water Surface - 17.4 acres (See Appendix 4)

b. Discharge at Damsite

Maximum flood at damsite - unknown

Low level outlet at pool elevation - 7 cfs

Ungated total spillway capacity at maximum pool elevation - 579 cfs

c. Elevation (ft. above MSL)

Top Dam - 523.6 minimum point
525.2 maximum point

Maximum pool-design surcharge (½ PMF) - 525.1

Recreation pool - 521.1

Spillway crest - 521.1

Upstream portal invert low level outlet (from design plans) - 515.6

Downstream portal invert low level outlet - 514.4

Streambed at centerline of dam - downstream - 513.4

Maximum tailwater (estimated) - 519

d. Reservoir (feet)

Length of maximum pool - 1920

Length of recreation pool - 1800

e. Storage (acre-feet)

Recreation pool - 174

Design surcharge (½ PMF) - 251

Top of dam - 218

f. Reservoir Surface (acres)

Top dam - 17.6

Spillway crest - 17.4

g. Dam

Type - earthfill

Length - 235'

Height - 10.2'

Top width - 10±

Side Slopes - Upstream - 3H:1V
Downstream - 3H:1V

Zoning - Clay fill on upstream side of spillway shown on plans.

Impervious core - none indicated on design plans

Cutoff - 1 foot thick concrete cutoff wall at downstream end of spillway indicated on design plans.

Grout curtain - none indicated on design plans

h. Spillway

Type - free overflow

Length of weir - 40' nominal, 39' effective length

Crest elevation - 521.1

U/S Channel - Rock Ridge Lake

D/S Channel - Denney Pond

i. Regulating Outlets

Type - One 12-inch part concrete and part cast iron low level outlet pipe.

Length - 72'±

Access - Concrete housing in center of concrete spillway apron just downstream of crest.

Regulating facilities - gate valve

SECTION 2
ENGINEERING DATA

2.1 Design

No plans, hydraulic, or hydrologic design data for the original Rock Ridge Lake Dam are available. Plans, hydraulic and hydrologic data for the rebuilt part of the dam and the spillway are on file at the New Jersey Department of Environmental Protection. The plans show an earth-filled dam with a 40-foot long, 12-foot wide spillway, with 4 expansion joints. The spillway apron is shown to extend for 9 feet downstream of the crest. The valve box with 12-inch gate valve is shown on the plans in the center of the apron by the downstream edge. The 12-inch diameter low-level outlet pipe is shown to be cast iron, with an intake upstream of the spillway and an outlet just below the gate valve.

2.2 Construction

No recorded data concerning construction of Rock Ridge Lake Dam were disclosed. Reference data on file with the New Jersey Department of Environmental Protection indicate that the dam was repaired and spillway rebuilt in 1949. The current Rock Ridge Lake Association president stated that concrete was added to the spillway in 1978 to repair erosion and undermining.

2.3 Operation

No engineering data pertaining to operation of the dam were disclosed.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files, contact with community officials and contact with the owner revealed a limited amount of recorded information. All disclosed information was retrieved.

b. Adequacy. Because of the limited amount of recorded data available, evaluation of this dam was based primarily on visual observations.

c. Validity. Parts of the recorded data reviewed did not agree with visual observations. Specific discrepancies are discussed in Sections 5.1 a. and 6.1 b.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. The crest of the dam appears to be used extensively as a footpath and is bare of vegetation. Large trees and a heavy cover of brush are growing on both the upstream and downstream slopes of the dam. Extensive erosion has occurred on the upstream slope next to the training walls on each side of the spillway and at two locations between the spillway and the west abutment. One large soft wet area was observed at the downstream toe near the right abutment. Brush, stumps, leaves, and grass clippings which have been dumped on the downstream slope of the dam near the west abutment and a very heavy growth of rose bushes, brush, and trees on the downstream slope and at the downstream toe of the dam make it impossible to inspect adequately for evidence of seepage along the entire length of the dam. A raft was floating against the upstream edge of the spillway crest.

b. Appurtenant Structures. The concrete spillway apron has an open and unsealed expansion joint. Several drill holes have been made in the top surface of the concrete middle apron of the spillway. The concrete weir and training wall exhibited evidence of minor spalling and surface erosion to a maximum depth of 1 inch. The concrete spillway apron appears to have been recently extended. The 12-inch low-level outlet pipe and valve appeared to be in fair condition but were not operated during the inspection. The service bridge beams and decking were in good condition.

c. Reservoir Area. The watershed above the dam is gently sloping and wooded. Slopes adjacent to the reservoir appear stable. Some homes and a bathhouse are located on the shore of the reservoir. No evidence of significant sedimentation was observed.

d. Downstream Channel. Two trees have blown over across the channel immediately downstream of the dam. Many trees overhang the area downstream of the dam.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed. Water is lowered every 2 or 3 years for dock maintenance purposes.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were disclosed.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were disclosed.

4.4 Warning System

No description of any warning system was disclosed.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 b. should be implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Design spillway capacity was based on "a 16K storm of 6 hours duration," which produced the maximum discharge for a 50-year storm. Several other durations were investigated. The peak inflow of 450 cfs was routed through the lake to obtain a peak outflow of 266 cfs. In a letter dated October 17, 1949 to Newell C. Harrison, Engineer for the owner, from H. T. Critchlow, Director and Chief Engineer for the State Division of Water Policy and Supply, a minimum freeboard of 2.5 feet is specified for a forty-foot long broad-crested spillway. Two hydraulic features of the structure did not agree with the original design plans. A one-foot wide concrete pier supports the service bridge which spans the spillway, and reduces the effective weir length to 39 feet and the freeboard to 1.8 feet. The downstream spillway apron was found to extend downstream about 42 feet. It appears that several downstream sections have been added to the spillway apron shown on the plans. The 12-inch low level pipe is concrete at its outlet. It is believed to be concrete pipe under the new spillway and is shown in the design plans to be cast iron pipe at the valve box. Engineering data are given in Appendix 1.

b. Experience Data. The original dam was overtopped and breached during a cloudburst on May 25, 1947. The peak inflow and frequency of the storm were not determined. The breach formed was about 30 feet wide by 30 feet long. Recorded descriptions are included in Appendix 1 and state that no significant property damage occurred. No experience data were disclosed regarding the current dam and spillway.

c. Visual Observations. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection, water less than one inch deep was passing over the spillway crest.

d. Overtopping Potential. The hydrologic/hydraulic evaluation of Rock Ridge Lake Dam is based on a spillway design flood (SDF) equal to one-half the probable maximum flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified Significant Hazard and small in size. The PMF has been determined by application of the SCS dimensionless unit hydrograph to a 24-hour PMP storm of 22.5 inches. Hydrologic computations are given in Appendix 4. The routed half-PMF peak discharge for the subject watershed is 2,197 cfs.

The minimum elevation of the dam allows 2.4 feet of depth in the spillway before overtopping occurs. Under this head, the spillway capacity is 579 cfs, which is less than the required SDF.

Flood routing calculations indicate that Rock Ridge Lake Dam will be overtopped for four hours to a maximum depth of 1.5 feet, under half-PMF conditions. It is estimated that the dam can pass less than 20 percent of the PMF without overtopping, thus the spillway is considered inadequate.

Because the dam was initially classified as high hazard based on visual observation, a breach analysis was performed to assess the increase in downstream hazard under dam failure conditions. The results of breach analysis, contained in Appendix 4, show that the downstream hazard is not increased under dam failure conditions. The inundation at the potential damage area downstream is such that the hazard is more appropriately classified as Significant.

e. Drawdown Capacity. If the low level outlet is in operable condition, it is estimated that the pond can be drained in approximately 13½ days, assuming no significant inflow. This time period is considered marginal for draining the reservoir in an emergency situation.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The use of the crest of the dam as a footpath and the absence of vegetation on the crest could lead to serious erosion of the dam if not remedied. If the trees growing on the upstream and downstream slopes of the dam blow over and pull out their roots, or if a tree dies and its roots rot, serious seepage and erosion problems may result. Erosion of the upstream slope at the spillway training walls and at two other locations, if allowed to continue, may lead to breaching of the dam. The large soft wet area near the west abutment, if uncorrected, could lead to a stability problem in the future.

Based on the visual inspection alone it is not possible to determine the physical properties of the foundation soil or the character of the interior of the cross section. Therefore, it is not possible to evaluate the factor of safety of the dam against slope failure. The open and unsealed joint and the open drill holes in the spillway apron could lead to rapid deterioration and undermining of the concrete in the apron.

b. Design and Construction Data. A drawing dated 1950 indicates that the existing cross section of the dam consisted principally of a sand and gravel fill and an upstream slope of "riprap over clay." A concrete cutoff wall is shown to be under the concrete spillway apron several feet downstream from the downstream edge of the crest of the dam. No riprap was found on the upstream face of the dam during the inspection.

c. Operating Records. An inspection report dated June 2, 1947 indicates that "on Sunday night, May 25, a severe cloud-burst occurred in this section of Morris County, resulting in the overtopping of the dam and washing out a section of the dam about 30 feet wide."

d. Post-Construction Changes. After the May 25, 1947 breach the dam was reconstructed based on design data included in Appendix 1.

e. Seismic Stability. Rock Ridge Lake Dam is located in Seismic Zone 1 and in accordance with the recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Rock Ridge Lake Dam is 53 years old and in fair condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 a. and the operating and maintenance procedures 7.2 c. should be implemented by the owner as prescribed below.

d. Necessity for Additional Information. The dam should be inspected again after the trees, brush, and debris have been removed from the downstream slope and downstream toe area. The information available from the present visual inspection is adequate to identify the potential problems that are listed in Sections 5 and 6. These problems will require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain the services of a professional engineer qualified in the design and inspection of dams to accomplish the following in the near future:

(1) Design and oversee procedures for removing trees and brush from the upstream slope, downstream slope and downstream toe area of the dam.

(2) Investigate the large soft wet area near the west abutment and design appropriate remedial measures.

(3) Inspect the downstream slope and toe of the dam after the trees, brush, and debris have been removed.

(4) Design and supervise repairs for the eroded areas on the upstream slope at the spillway training walls and at two locations between the spillway and the west abutment.

(5) Conduct a more detailed hydrologic and hydraulic analysis of the spillway to determine the need and type of remedial measures necessary.

(6) Design repairs to the concrete spillway apron and areas of spalling and erosion on the weir and training wall.

(7) Provide a paved surface for the walkway on the dam crest.

(8) Establish grassy vegetation or other protective covering on the cleared slopes and remaining portions of the crest of the dam.

(9) Investigate the need to install an upstream valve on the low level outlet pipe to relieve constant pressure in the pipe in the embankment as it presently exists.

b. Operating and Maintenance Procedures. The owner should:

(1) Remove the raft floating against the upstream edge at the spillway crest. This should be done immediately.

(2) Check the condition of the dam periodically and monitor the seepage at the wet area at the downstream toe until remedial measures are effected. This should be started immediately.

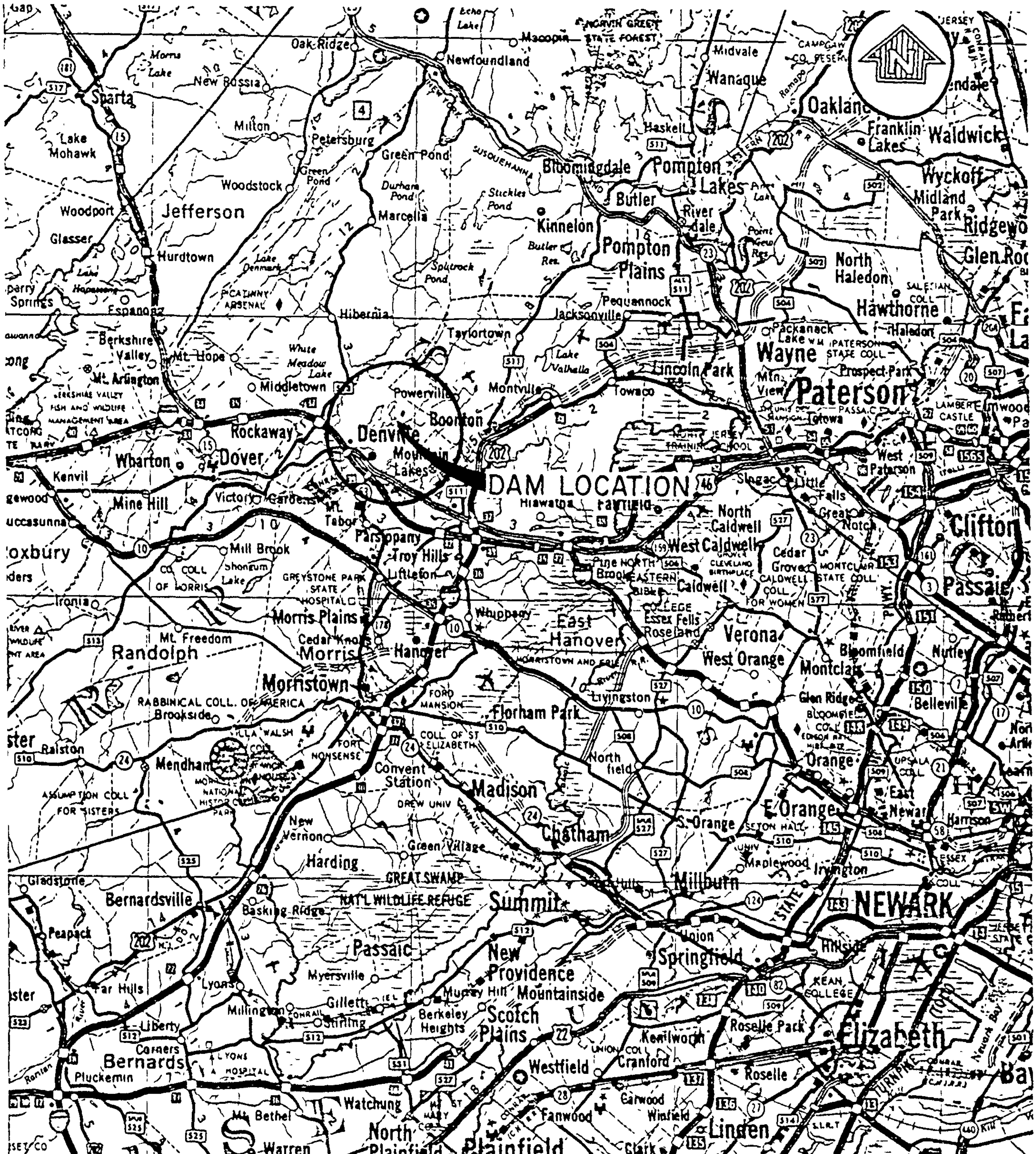
(3) Remove the two trees that have fallen into the discharge channel. This should be done soon.

(4) Clear trees and brush on either side of the discharge channel. This should be done soon.

(5) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure. This should be done in the near future.

(6) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years. This should be started in the near future.

(7) Periodically operate the low level outlet valve to prevent silting and seizing by rust. This should be started soon.



Anderson-Nichols & Co., Inc. BOSTON MASSACHUSETTS	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

ROCK RIDGE LAKE DAM
LOCATION MAP

TRIBUTARY TO ROCKAWAY RIVER NEW JERSEY

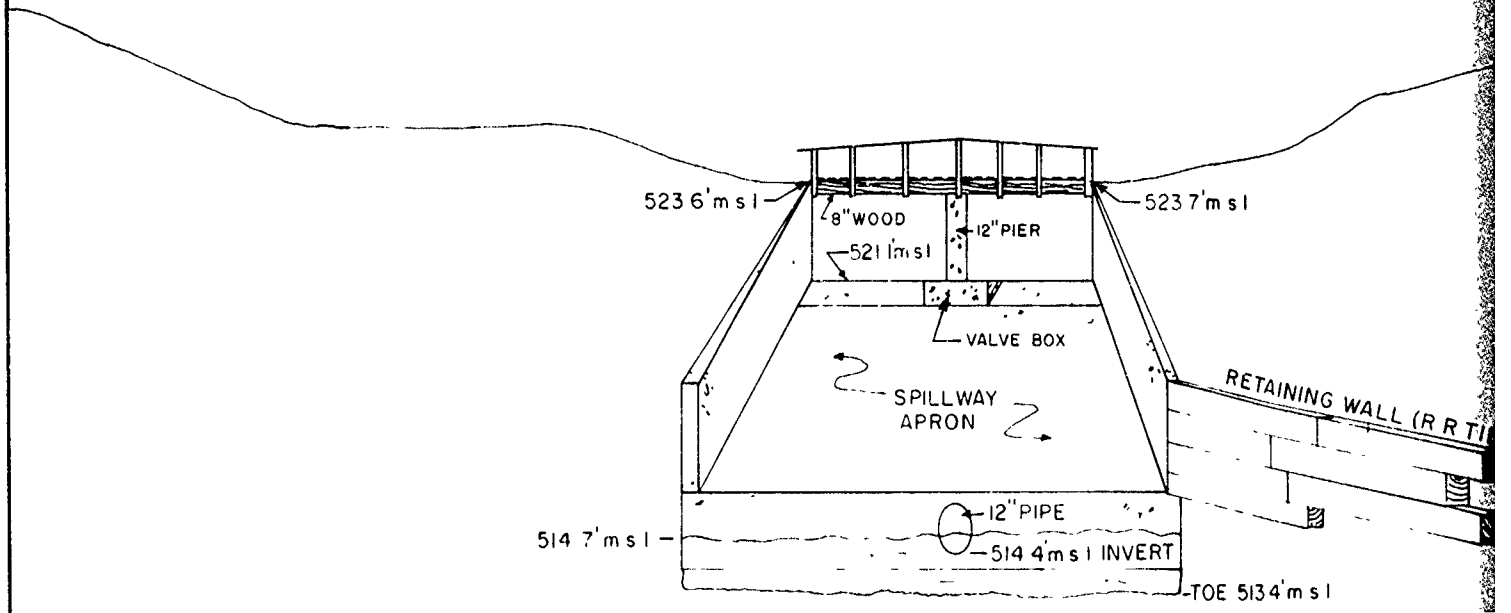
SCALE SEE BAR SCALE

DATE

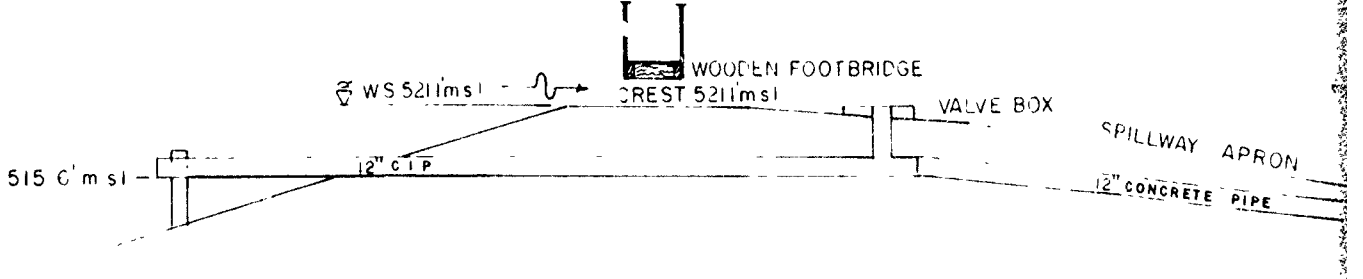
SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW JERSEY OFFICIAL HIGHWAY MAP AND GUIDE

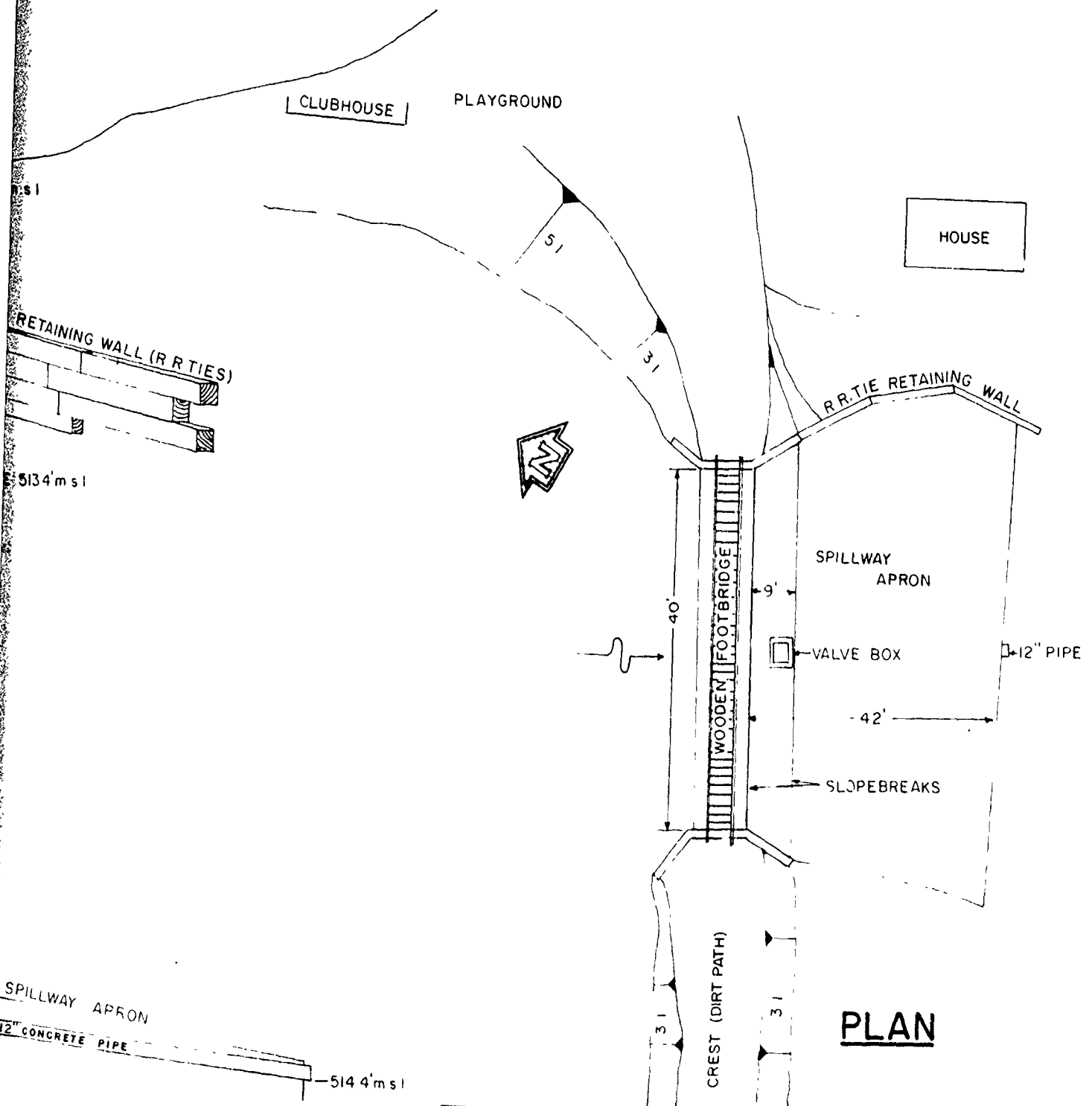


ELEVATION



SPILLWAY SECTION

Data from field inspection 5-17-79 and design



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U S ARMY ENGINEER DIST PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

ROCK RIDGE LAKE DAM

ROCK RIDGE LAKE NEW JERSEY

SCALE NOT TO SCALE
DATE JULY 1979

APPENDIX 1

ENGINEERING AND EXPERIENCE DATA

ROCK RIDGE LAKE DAM

The required capacity of the spillway was determined as follows:

(1) The storm duration which would produce the maximum discharge for a storm of estimated 50-year frequency was determined by the approximate computations shown on Sheet #1, attached. A 16K storm of 6 hours duration, when routed through the lake, was shown to produce a maximum discharge over the spillway.

(2) Central Jersey curve run-off is estimated to represent the peak flow from a 15-year flood in this watershed. The ratio of a 6-hour duration, 50-year frequency flood to a 6-hour duration, 15-year frequency was estimated from the rainfall I-D curves to be 1.22. Thus, a 50-year flood peak is estimated at 436 c.s.m. (Central Jersey) x 1.22 = 533 c.s.m., or 450 sec. ft. By using 450 sec. ft. as the peak inflow into the lake during a 16K or 6-hour storm, an inflow hydrograph was plotted and the flood routed through the lake as shown on Sheet #2, attached.

The maximum discharge for this flood is 256 second feet.

DONE BY STATE WATER POLICY COMMISSION
(see header on left of next page
DATE 1/10/50

NOTE: EXTENSIVE HYDROLOGIC COMPUTATIONS BACKUP IS ON FILE WITH N.J. DEP IN MICROFICHE FORM. COPIES OF A QUALITY SUITABLE FOR REPRODUCTION WERE NOT OBTAINABLE AND THUS HAVE NOT BEEN INCLUDED IN THIS REPORT

STATE WATER POLICY COMMISSION

ROCK RIDGE LAKE - SUPPRESSION COMPUTATIONS for Appl. 440

to Determine 50-YR. PEAK DISCHARGE

K = 2.2 sq mi, Ac. 1370 acres, SPILLWAY = 40 Ft. Lg, C = 2.66 SHEET 1 OF 2

COMPUTED SPILLWAY CREST = Elev 98.00 CHECKER [illegible] DATE 1/12 1950

(1) STORM DURATION	(2) LAKE LEVEL at INFLOW PEAK Elev.	(3) CORRECT'D SPILLWAY DISCHARGE Sec.Ft.	(4) DISCH. VOL. up to INFLOW PEAK Ac.Ft.	(5) STORAGE VOL. up to INFLOW PEAK Ac.Ft.	(6) INFLOW VOL. up to INFLOW PEAK Ac.Ft.	(7) TOTAL INFLOW VOLUME Ac.Ft.	(8) INFLOW PEAK Sec.Ft.	(9) SEE NOTE BELOW M	(10) SEE NOTE BELOW %	(11) DISCHARGE PEAK Sec.Ft.	(12) LAKE LEVEL at time of MAX. DISCH. Elev.	(13) RUN-OFF RAINFALL R. COEFF.	(14) TOTAL RAINFALL VOLUME Ac.Ft.	(15) TOTAL RAINFALL Inches	(16) AVERAGE RAINFALL In./Hr.	(17) CORRECT'R STORM PREC. %	(18) 50-YR. DISCH. Sec.Ft.
2K	98.5	380	.97	10.25	11.12	30.9	533	12.1	15.0	82.0	98.85	.30	103.0	2.30	3.07	50	220
8K	99.2	128	9.8	24.16	33.96	77.3	556	24.8	40.0	223	99.66	.46	168.0	3.76	1.25	45	229
	99.35	143	10.4	25.19	35.59	82.9	562	26.0	41.5	235	99.71		176.0	3.94	1.3	45	
6K	99.5	192	24.5	30.25	54.25	108.50	487	44.2	55.5	259	99.83	.60	181.0	4.04	1.51	33	
	99.6	211	26.8	32.80	59.60	119.20	513	41.2	55.7	285	99.95		[illegible]	[illegible]	[illegible]	40	
	99.65	222	28.2	33.83	62.03	124.06	535	41.5	56.0	300	100.20		267.0	4.03	[illegible]	50	
24K	99.45	222	41.9	33.83	75.73	140.0	418	54.0	65.0	272	99.90	.60	233.0	[illegible]	[illegible]	[illegible]	

Notes:

Col. 4 = Computed at mean rate of discharge

Col. 5 = Computed from Col. 6 using appropriate ratio shown on family of curves

Col. 8 = Computed from Col. 6 using appropriate factor "C"

Col. 9 = Ratio of discharge rate at time of peak inflow to the peak inflow rate. Peak discharge rate occurred at time

Col. 10 = Ratio of peak discharge rate to the peak inflow rate. Peak discharge occurred at time

from inflow hydrograph by extending discharge hydrograph to Col. 10.

Col. 11 = Determined from Col. 8 using percent given in Col. 10.

Col. 13 = Estimated coefficients for various lengths of storm duration

Col. 14 = Col. 7 by coefficient in Col. 13.

Col. 15 = Inches of rainfall in Col. 14 over entire area.

Col. 16 = Obtained from appropriate rainfall-frequency curves.

Result: 16K storm has mid-rate of discharge over spillway. Proceed with hydrograph routing.

Form 11-60-1949

Dam Application No. 110 (25-154)

State of New Jersey

State Water Policy Commission

REPORT ON DAM APPLICATION

To the State Water Policy Commission,
State of New Jersey.

Gentlemen:

The application of William Wetmore, Rock Ridge Lake, Denville, N. J.

filed December 16, 1949 for approval of plans and for a permit to reconstruct a dam known as Rock Ridge Lake on a small branch of the ~~xx~~ Rockaway River ~~xxxxxxxxxx~~ in Denville, in Morris County, New Jersey, has been examined by Norman C. Wittwer, Principal ~~Assistant~~ Hydraulic Engineer.

PRINCIPAL FEATURES

Location 25.4.1.7.1 ⊡		Site inspected 9/21/49 - N.C.W.	
Purpose of dam	Summer colony	Length of dam	175± feet
Drainage area	0.84 sq. mi.	Elevation of flow line	93.00 (Assumed datum)
Area of Lake	20.5 acres	Capacity of lake	16± Mil. gals.
Type of dam	Earth embankment	Top width	12' feet
Upstream slope	2:1 riprapped	Downstream slope	2:1
Foundation material	Unknown	Max. height	8.5± 2.6± feet
Type of spillway	Concrete broad-crested weir, C =	Length of spillway	40 feet
Max. head on spillway	1.95 feet with .55-foot freeboard		
Spillway capacity	266 sec. ft. = 318	sec. ft per sq. mi.	(See reverse side)
Estimated maximum flood flow, inflow peak =	450	sec. ft. per sq. mi.	(Est. 50-year flood)
Outlets other than spillway	12" C.I. pipe and gate valve		
Drawings filed by	Howell C. Harrison, Engineer, License No. 766		

It has been found that the site for the dam is suitable and the plans adequate to ensure the construction of a structure which will not be a menace to life or property. It is therefore recommended that the plans be approved and that a permit be issued, subject, however, to the following terms and conditions:—

1. That this permit does not give any property rights, either in real estate or material, nor any exclusive privileges; neither does it authorize any injury to private property nor invasion of private rights, nor any infringement of Federal, State or local laws or regulations, nor does it waive the obtaining of Federal assent, when necessary.

Form 13—12—30-48

STATE OF NEW JERSEY

DEPARTMENT OF CONSERVATION & ECONOMIC DEVELOPMENT

DIVISION OF WATER POLICY AND SUPPLY

28 WEST STATE STREET

TRENTON, NEW JERSEY

DAM APPLICATION No. _____

APPLICATION FOR PERMIT FOR CONSTRUCTION OR REPAIR OF DAM

Denville, Morris County, New Jersey

December 15, 1949

To the Division of Water Policy and Supply,

Gentlemen:—

In compliance with the provisions of Title 58, Chapter 4, Revised Statutes

William Wetmore, Rock Ridge Lake, Denville, Morris County, New Jersey
(Here insert name and address of public authority, private person or corporation which will be the owner of the dam)

hereby makes application for the approval of drawings and for the issuance of a permit to construct (reconstruct, repair) a dam known as Rock Ridge Lake Dam
(Here insert name of dam)

across Rockaway river (Here insert name of stream) in Morris County, New Jersey,

at a point near the boundary line between Boonton Township and Borough of Denville
(Here give location by distance from mouth of stream, county or municipal boundary or other political feature)

for the purpose of real estate development
(Here state the purpose of the proposed dam)

in accordance with the following information and with the complete specifications and drawings filed with this application and made part hereof, as follows:

Area of water shed 1.25 square miles.

Maximum depth of lake 12 feet.

Area of water surface 30 acres.

Capacity of spillway at 2 feet head, is 400 cubic feet per second.

The character of the foundation material is from observations made by excavation through the section of the present dam, found to be clay and large boulders.

As determined by _____

October 17, 1949

Mr. Merrill C. Harrison
98 High Street
Butler, New Jersey

Re: Rock Ridge Lake Dam - Morris County

Dear Mr. Harrison:

In accordance with the promise made to you by Mr. Norman C. Rittror of this office relative to the spillway requirements for the Rock Ridge Lake Dam across a small branch of the Rockaway River in Denville, a restudy of this question has been made. By evaluating the effect of suppression by the lake upon the magnitude of flood discharge peaks, it has been determined that a broad-crested spillway having a length of 40 feet between end walls can be considered favorably by this Division, provided the minimum freeboard between spillway crest and the top of the dam is not less than 2.5 feet.

Yours very truly,

H. F. Critchlow
Director and Chief Engineer

HFC:MRB

Report on Dam Inspection

ROCK RIDGE LAKE

BRANCH OF ROCKAWAY RIVER

DENVILLE TOWNSHIP, MORRIS COUNTY

On May 29, 1947 inspection was made of the subject dam, in company with Mr. H. A. Heller, President of the Rock Ridge Community Club, and Mr. Walter Reise, member of the Board of Governors of the same club. The present dam is an earth fill dam without core wall, approximately 10 feet wide at the top. The spillway consists of an open concrete sluice 8 feet wide with notches in the upstream face of the concrete to receive flashboards. The normal water level, according to Mr. Heller, has always been maintained not over 6 inches below the top of the dam. The drainage area is .54 square miles. The front of the dam was completely silted in and downstream from the dam was so completely overgrown that it was difficult to determine the exact height of the dam. However, it was estimated at approximately 8 feet.

On Sunday night, May 25, a severe cloud-burst occurred in this section of Morris County, resulting in the overtopping of the dam and washing out a section of the dam about 30 feet wide. The washed out section is approximately 30 feet distant from the sluiceway. Mr. Heller advised that all the flashboards were in at the time of the cloud-burst. At the time of this inspection trucks were already hauling in fill to close the gap in the dam, and a bulldozer was at work moving the fill and compacting same. Sand bags were being placed upstream of the gap for a width of about 6 feet and were being added as the fill was being placed. The intention is to back up the new fill with a "backstop" of rocks.

Rock Ridge Lake is one of several lakes in this region which is the center of a colony of homes, approximately 50 per cent winter and 50 per cent summer homes. The writer appreciates the urgency of making temporary repairs to this dam in order that the lake can be restored for the summer season. Therefore, the work was not ordered stopped but was permitted to proceed according to present plans, subject to confirmation from this office. Channel conditions between the dam and Rockaway River were examined and it is apparent that no damage resulted from the failure of this dam. The only house adjacent to the flood plain of the stream is the residence of F. Hemm on the northerly side of Diamond Spring Road and west of the stream. Mr. Hemm assured the writer that no damage was done to his property. The bridge over Diamond Spring Road at this point is 20 feet high, wide, with a clear opening of 4 feet above present water level and the underclearance of the bridge. Mr. Hemm stated that the Sunday night flood rose to within 3 inches of the underclearance of the bridge. It is reported that Cedar Lake dam was also overtopped but that no damage was done.

It is recommended that permission be granted for the temporary restoration of the dam as outlined above, on condition that the club will immediately engage an engineer to prepare drawings for permanent construction of the dam with adequate cutoff wall in the new fill and adequate overflow spillway capacity satisfactory to this Division. This, Mr. Heller and Mr. Reise agreed to do. Copies of the dam booklet and application blanks were left with Mr. Heller.

Norman C. Wittwer
Hydraulic Engineer

Trenton, N. J.
June 2, 1947

THOMPSON-STARRETT COMPANY, INC.
GENERAL CONTRACTORS AND BUILDERS
444 MADISON AVENUE

ADDRESS ALL COMMUNICATIONS TO THE COMPANY

NEW YORK 22, N.Y.

May 27,1947.

Mr.H.T.Critchlow,
Chief Engineer, Division of Water Policy Commission,
N.J.Department of Conservation & Developement,
28 West State Street,
Trenton, N.J.

Re.Earth Dam at Rocky Ridge Lake,
Danville, N.J.

Dear Sir:-

On Monday morning May 26,1947, at 9 A.M.,a portion of the Earth Dam constraining the water of the Rocky Ridge Lake gave way and resulted in the following:

1.The loss of 5'-0 head of water.
2.A portion of the Dam roughly 30'-0 wide and 30'-0 long washed out.

The following method will be used to repair the break:

1.On the Lake side sand bags will be placed in such a manner as to form a base 6'-0 wide and graduating to the top of the new fill the full width of the cut.
2.On the rear side of the Dam, a back-stop of rocks 10'-0 wide,the full width of the cut will be used to hold in the fill which will consist of clay and earth,The crest of the new fill will be kept approximately 2 to 3 feet above high water mark.The full depth of the new fill in a horizontal direction will be about 30'-0.

The repair job will start under my supervision at once and unless other instructions are received from you the work will be done as outlined.

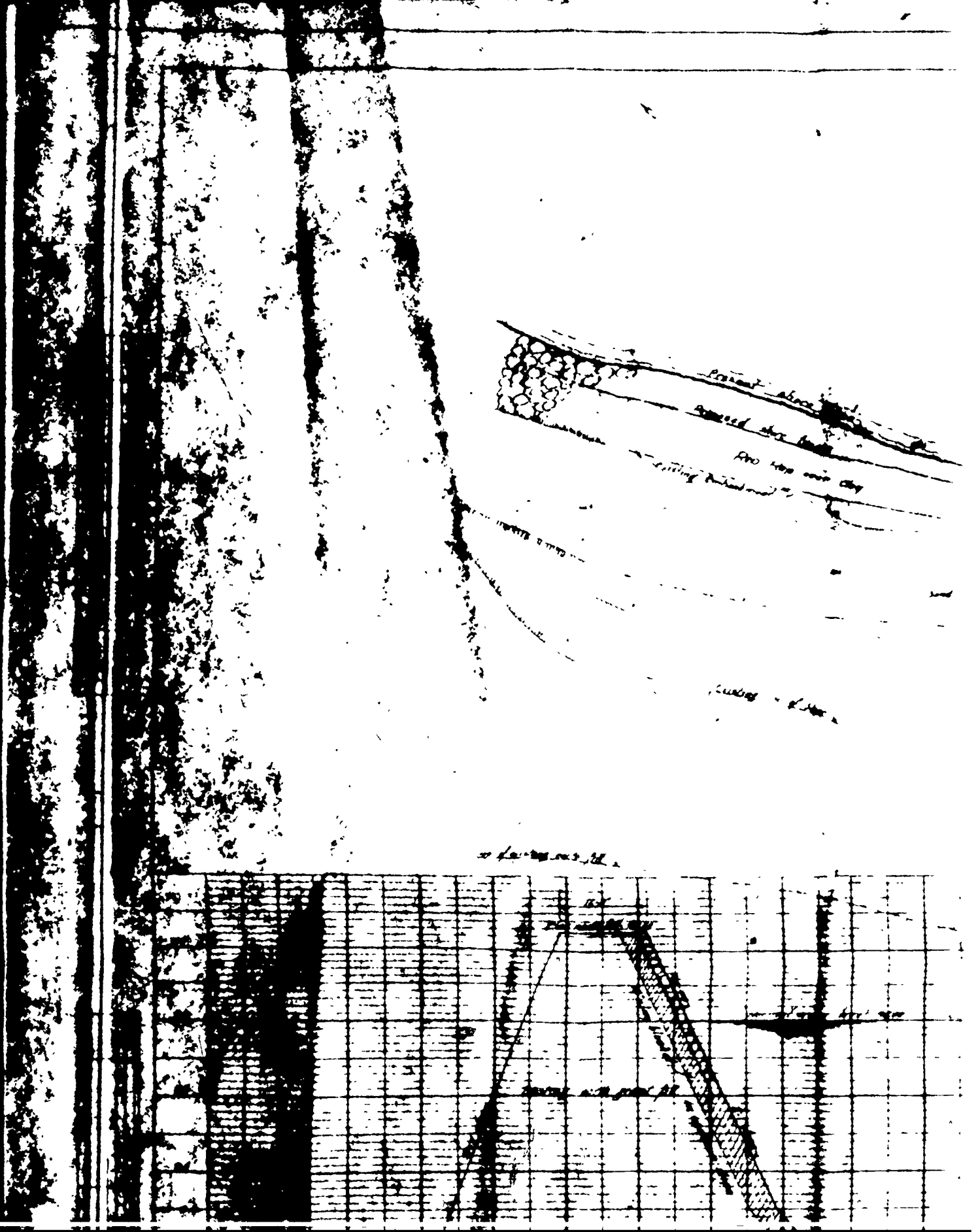
Very truly yours,
Walter (illegible)
Asst.Supt.
Box 186,
Denville, N.J.

APPENDIX 2

CHECK LIST

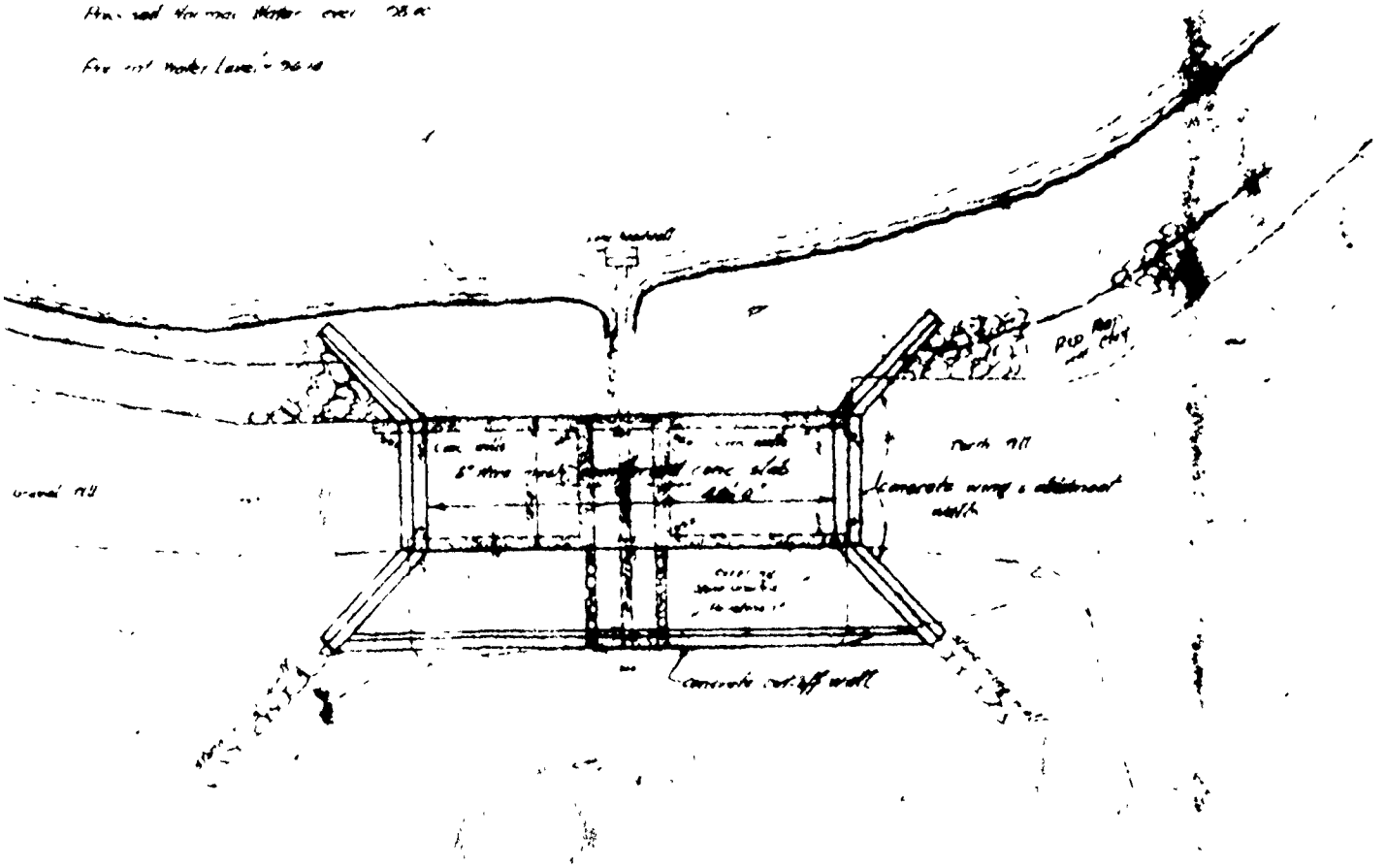
VISUAL INSPECTION

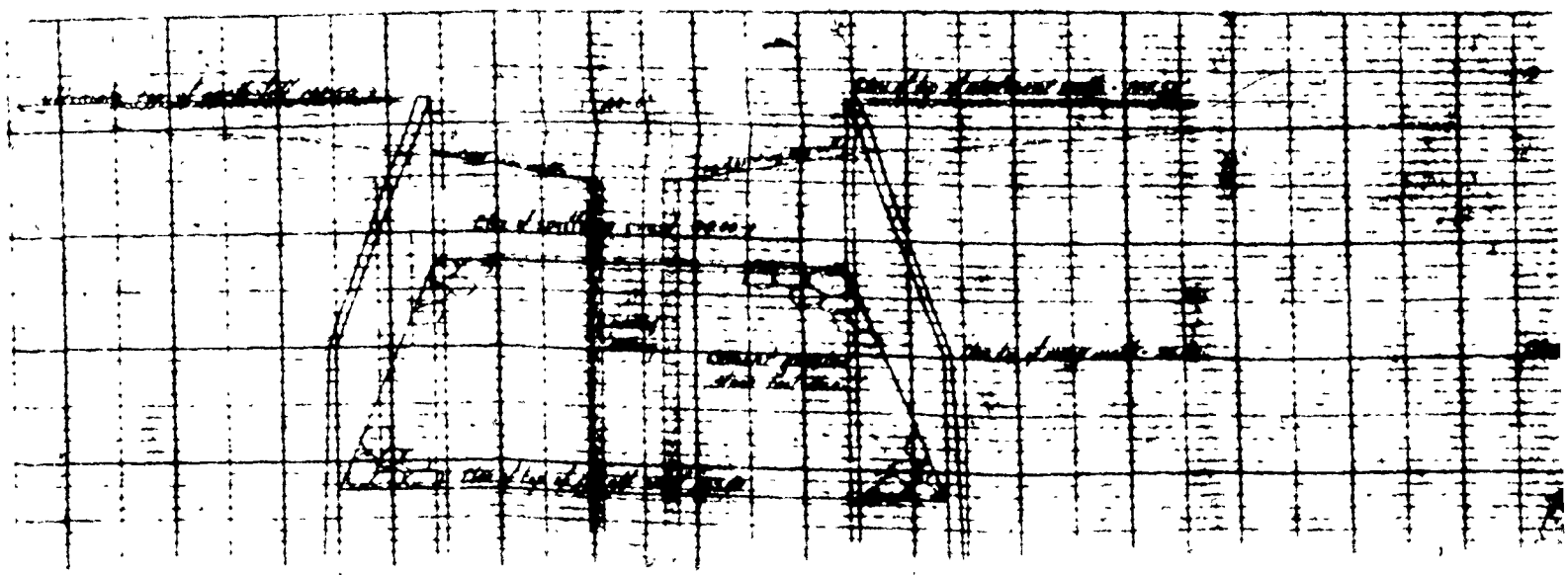
ROCK RIDGE LAKE DAM

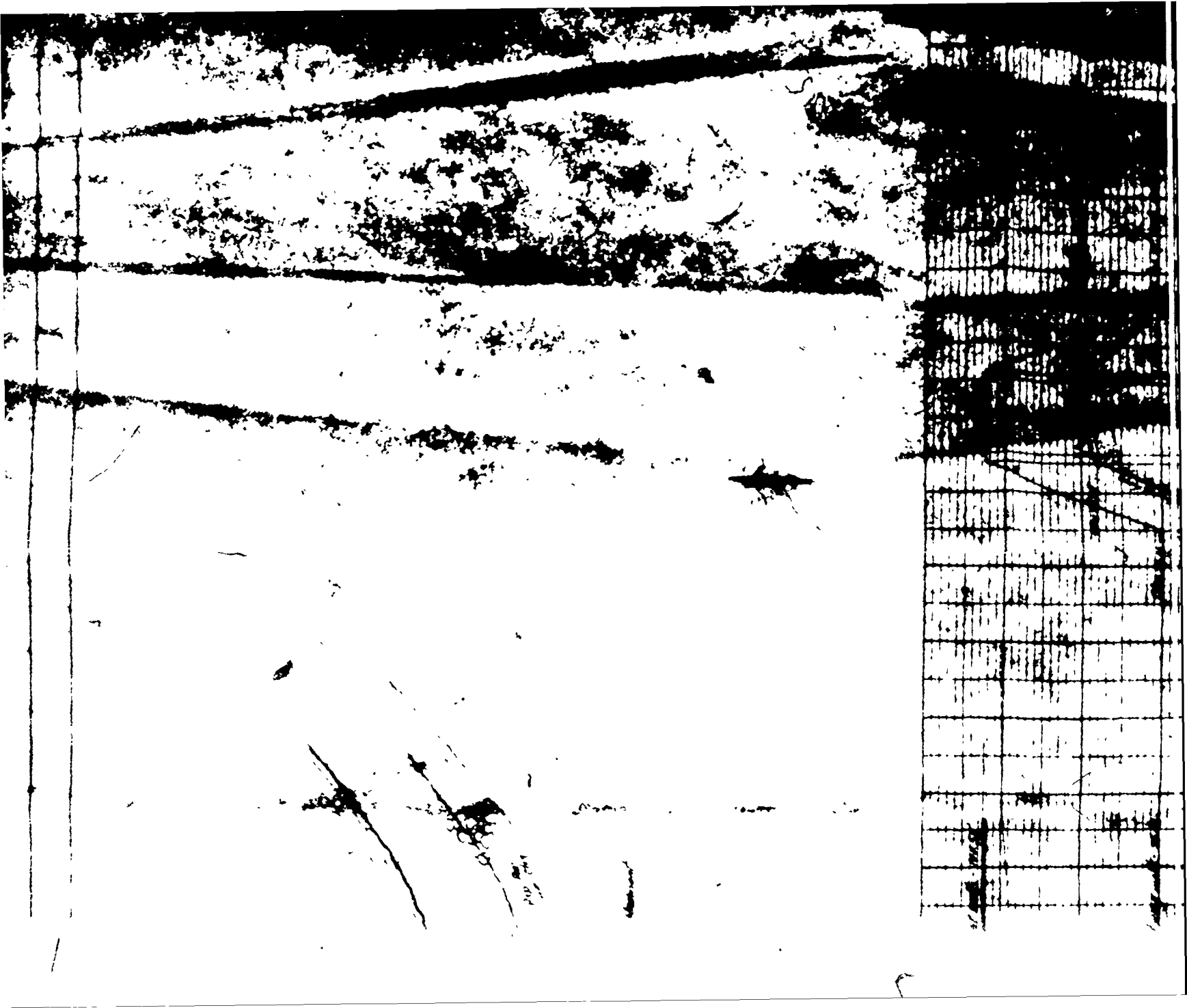


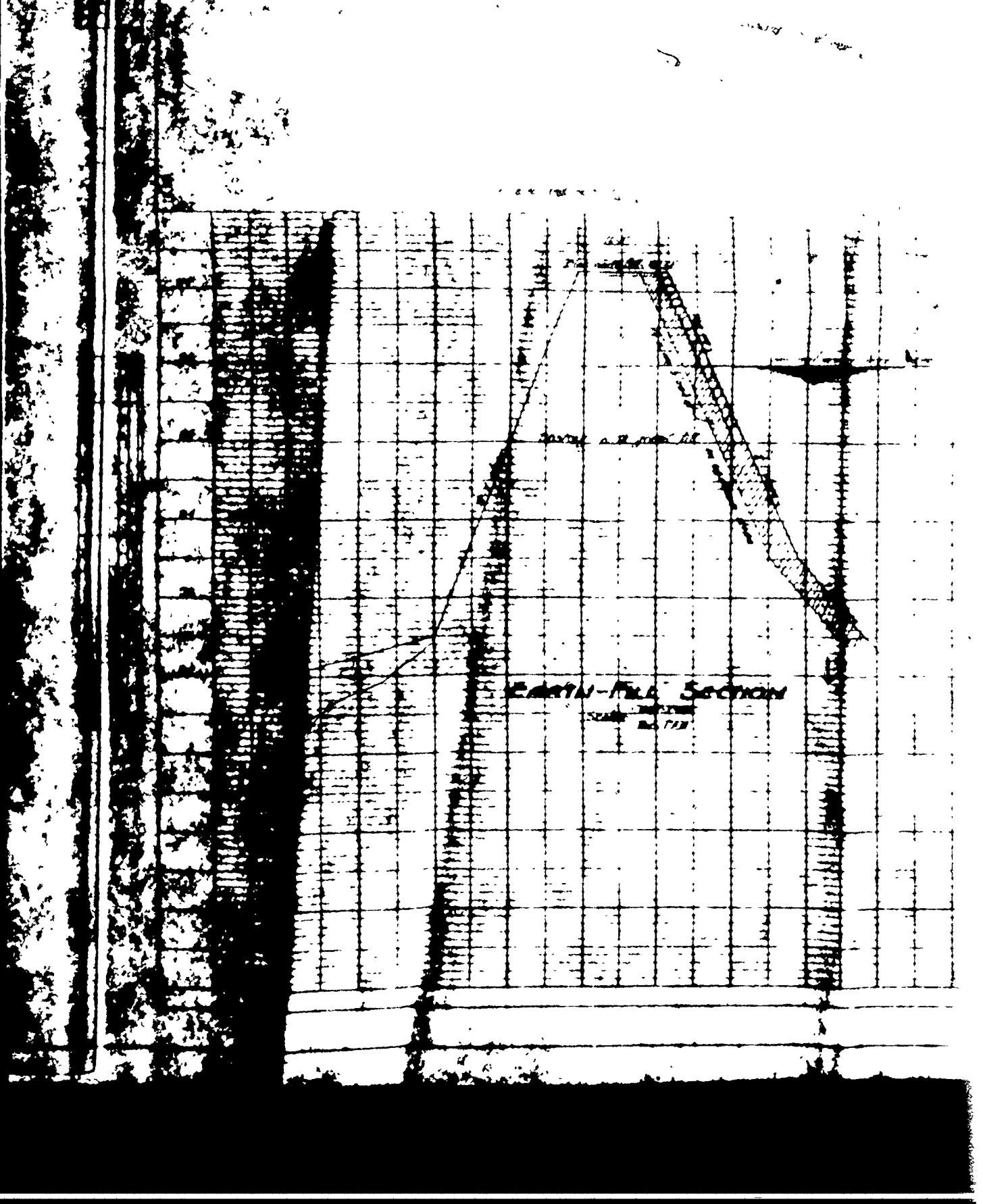
PLAN

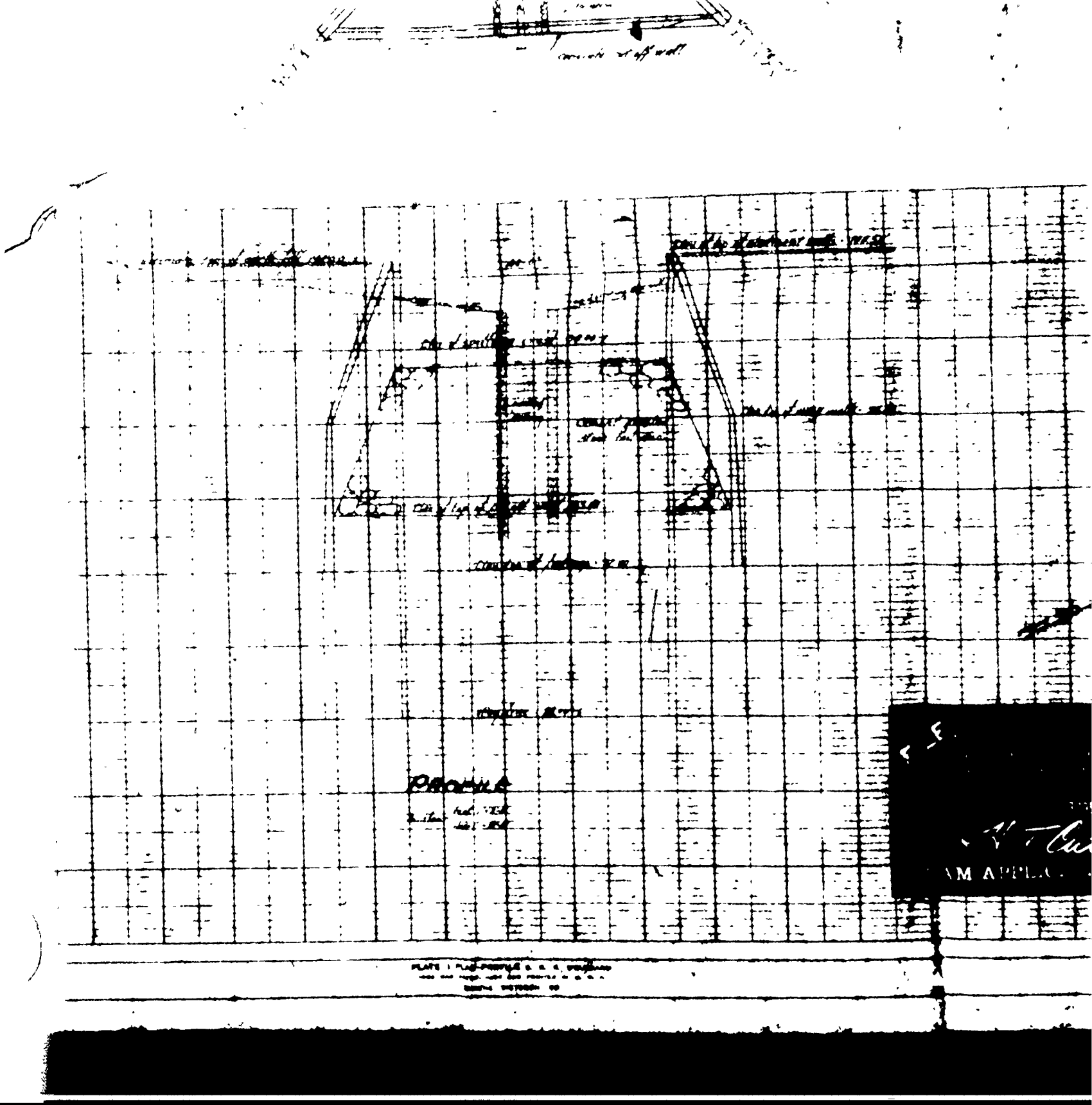
ROCK RIDGE LAKE



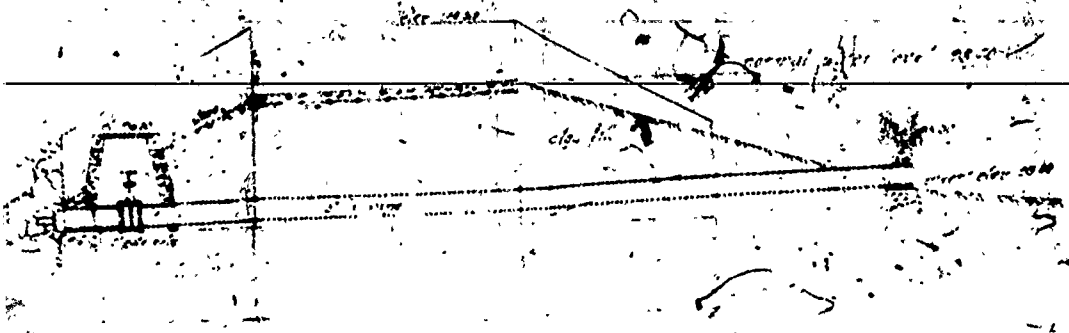





Earth-Fill Section



SPILLWAY DETAIL



SECTION A-A

PLANS & PROFILES

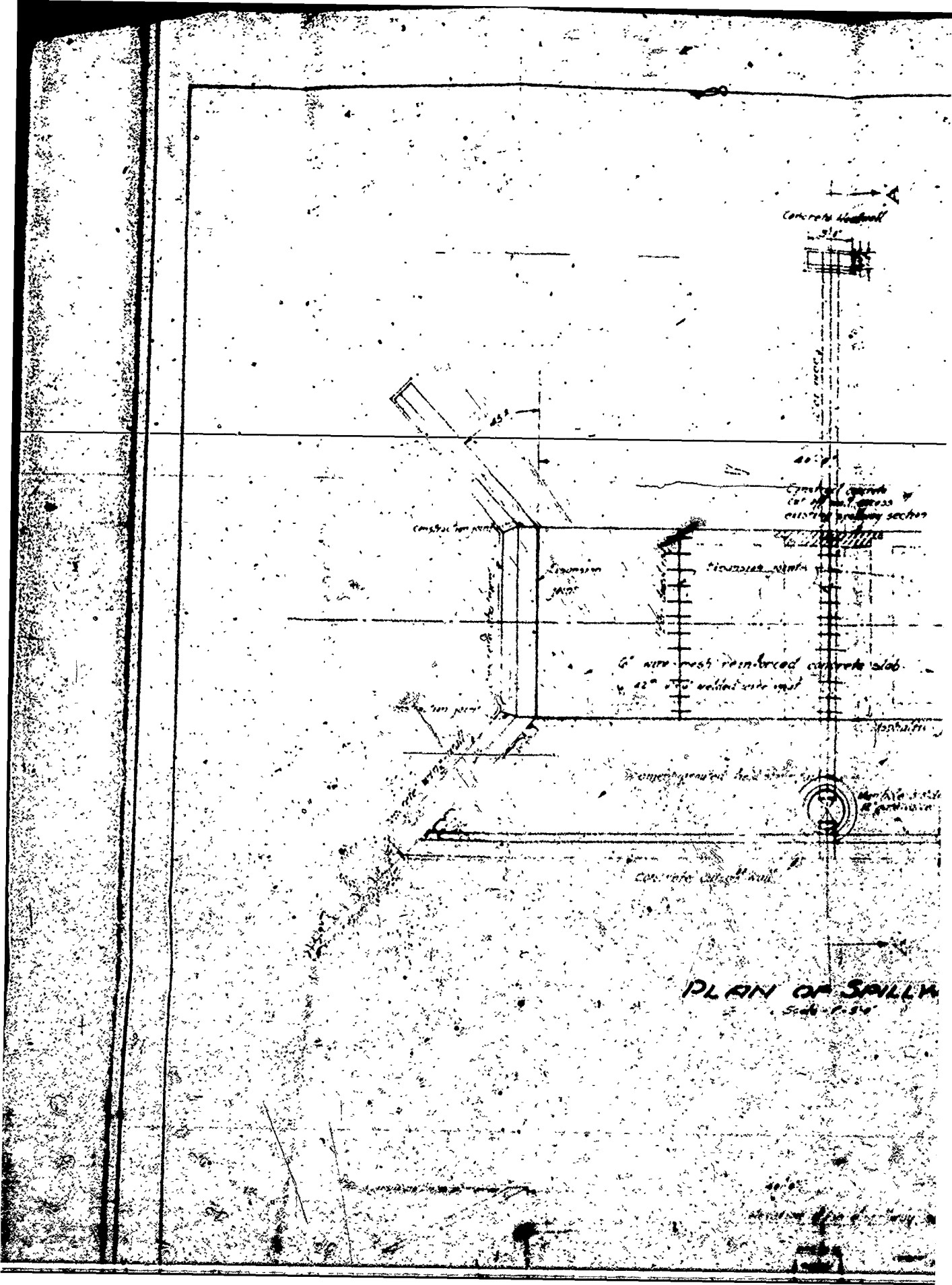
FOR THE RECONSTRUCTION & EARTH FILL OF

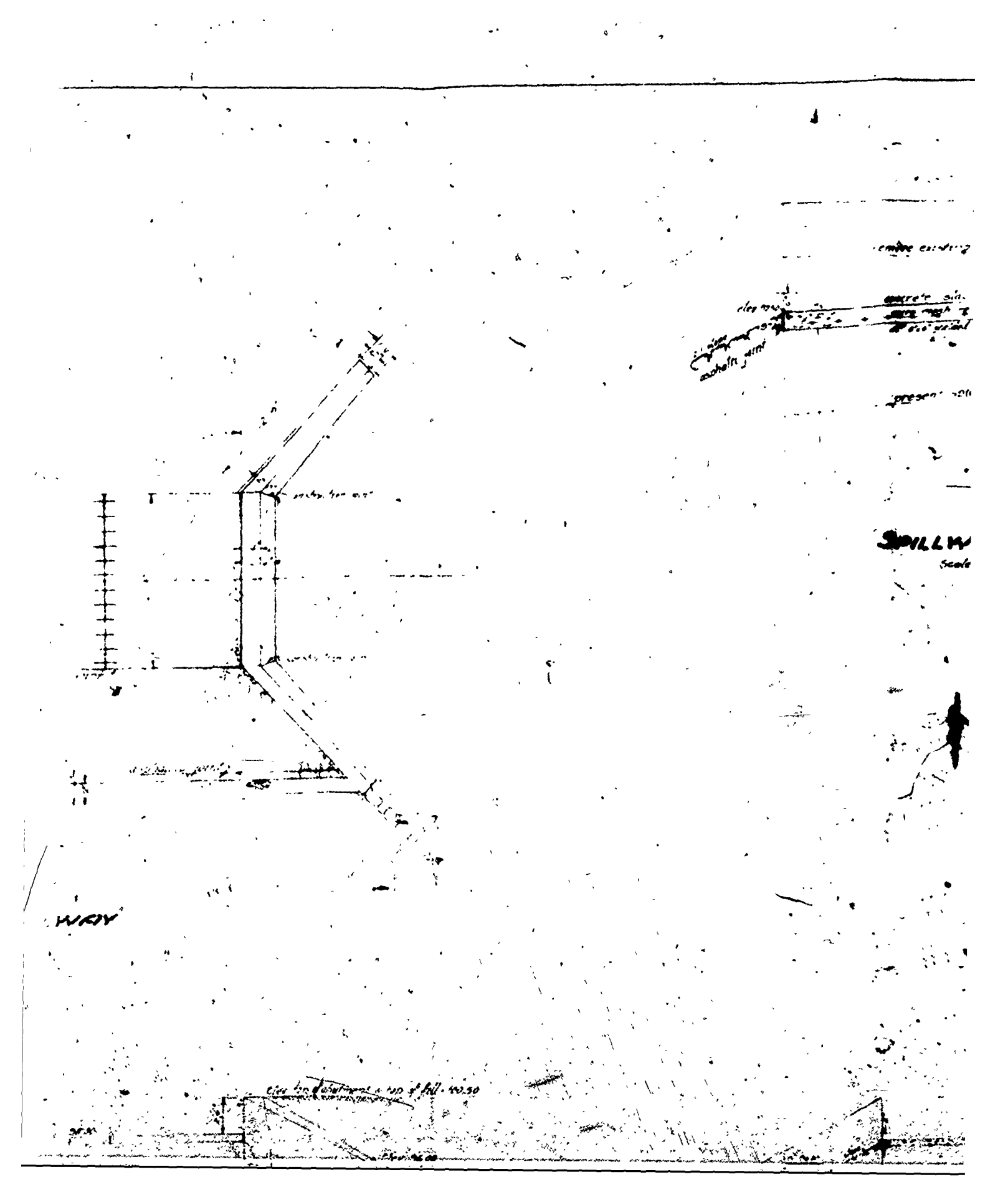
ROCK RIDGE LAKE

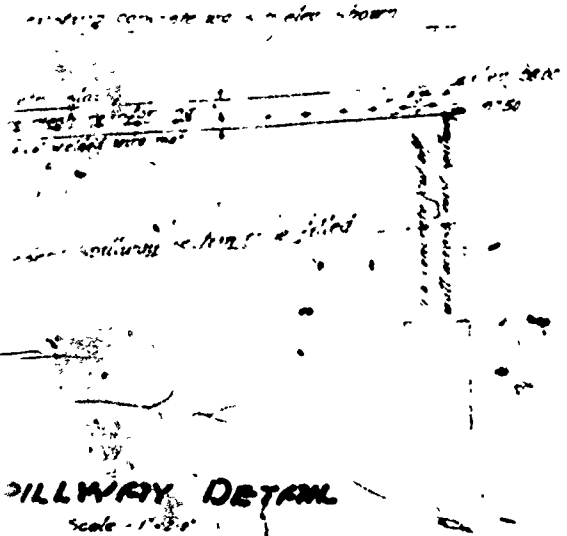
DESIGNED BY

Maurice C. Harrison
Prof. Engineer
Baldwin Mich.

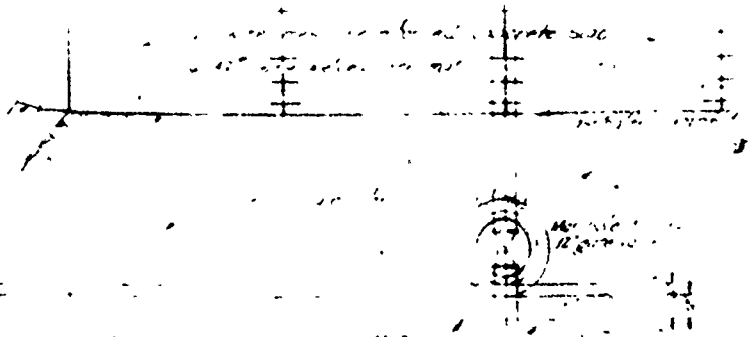
2/2


A
Concrete Headwall
45°
Expansion joint
6" wire mesh reinforced concrete slab
PLAN OF SPILLW

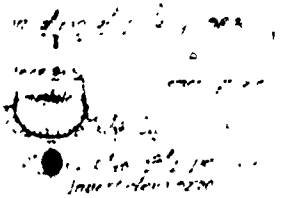




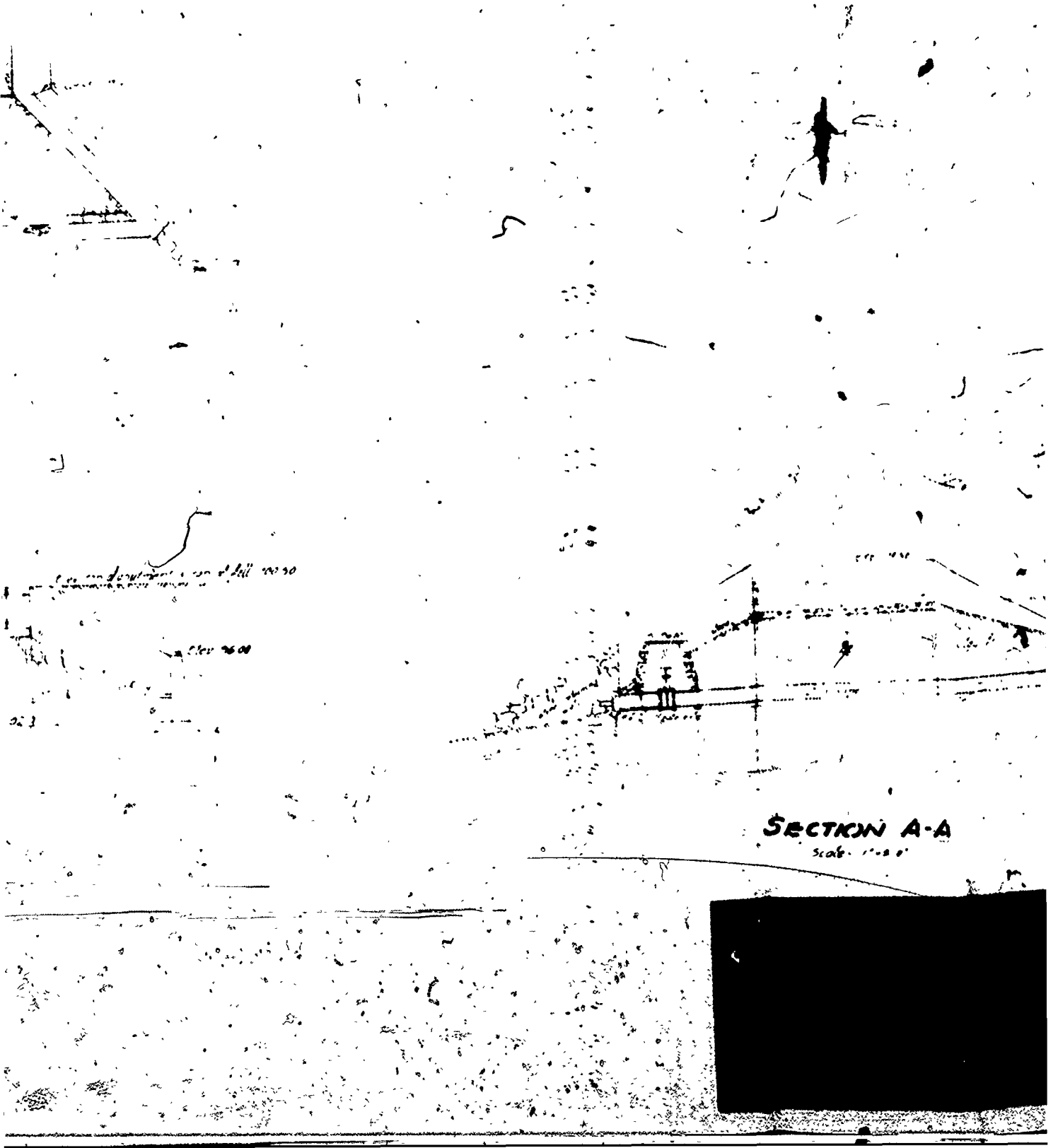
SPILLWAY DETAIL



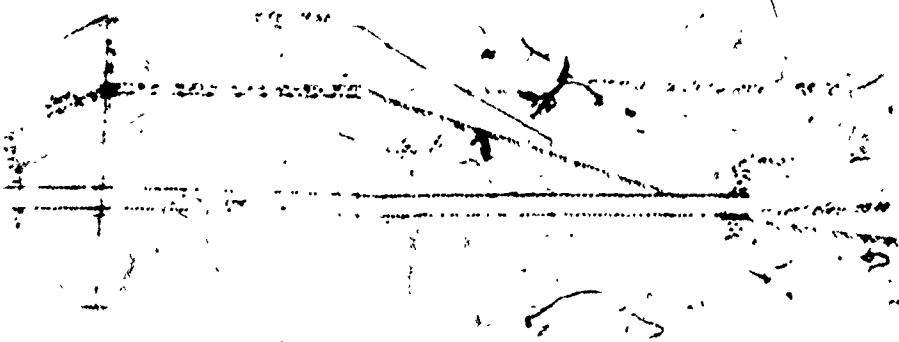
PLAN OF SPILLWAY



SPILLWAY ELEVATION



SECTION A-A



SECTION A-A

PLANS & PROFILES

FOR THE RECONSTRUCTION OF EARTH FILL DAM

ROCK RIDGE LAKE

IN VALLEY HARRIS COUNTY, NEW JERSEY

SCALES AS SHOWN

Clinton C. Harriman
Prof. Engineer
Baldwin N.J.

2/2

Check List
Visual Inspection
Phase 1

Name Dam Rock Ridge Lake Dam County Morris State New Jersey Coordinators NJDEP

Date(s) Inspection May 16, 1979 Weather Sunny Temperature 70°

Pool Elevation at Time of Inspection 521.0 MSL Tailwater at Time of Inspection 514.7 MSL

Inspection Personnel:

Warren Guinan	Ronald Hirschfeld
Stephen Gilman	
David Deane	

Gilman and Hirschfeld Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None apparent.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None apparent.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Crest of dam is bare of vegetation because of its use as footpath. Evidence of trespassing and erosion at several locations on upstream face. Also, see "JUNCTION OF EMBANKMENT..." below.	Provide walkway surface on crest of dam. Prevent trespassing on slopes. Repair erosion and establish grassy vegetation.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	No riprap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion of embankment next to right and left training walls on upstream side of spillway structure.	Repair erosion and establish grassy vegetation.
ANY NOTICEABLE SEEPAGE	Wet area at downstream toe near right abutment.	Downstream toe could not be adequately inspected because of dense growth of rose bushes and other vegetation and cover of brush, stumps, leaves, and grass clippings which have been dumped on much of downstream face near right abutment.
STAFF GAGE AND RECORDER	None apparent.	Vegetation and debris should be removed from entire embankment.
DRAINS	None apparent.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Concrete valve box good condition, only surface laitance eroded away. Steel plate cover; surface rusted only, not in place at time of inspection.	Steel cover should be put back in place.
INTAKE STRUCTURE	None.	
OUTLET PIPE	12" concrete pipe, fair condition. Surface of pipe eroded exposing aggregate.	Investigate the need for inlet valve. Outlet valve is under constant pressure.
OUTLET CHANNEL	Sand and gravel channel bottom. Trees and brush overhanging channel. Two small (6-inch) trees have fallen across channel.	Clear trees and brush 25 feet on either side of channel for a distance of 100 feet downstream from the dam. Remove trees that have blown over into channel.
EMERGENCY GATE	12" gate valve in good condition, appears to be in operable condition.	Valve should be operated periodically to prevent silting and rusting.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Upper portion has only surface erosion to ¼" exposing coarse aggregate. Numerous spalled areas 1" maximum depth. Lower portion constructed recently, in good condition. Abutments in good condition with minor undermining at water line.	Spalled areas should be repaired.
APPROACH CHANNEL	Wide and unobstructed.	
DISCHARGE CHANNEL	Channel has same width as spillway apron. Channel bottom is sand and gravel Trees and brush overhanging channel. Two 6-inch trees have fallen across channel.	See "Outlet Channel" under "Outlet Works" above.
BRIDGE AND PIERS OVER SPILLWAY	Concrete pier in good condition, with minor undermining at water line. Railings and bridge deck of untreated wood are surface weathered, in fair condition. Steel bearing plate is surface rusted.	Bridge should be painted.
EXPANSION JOINTS	2 expansion joints, not sealed, compressible joint material weathered and eroded. Upper expansion joint seems to have separated approximately ¼".	Joints should be cleaned and resealed.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None apparent.	
OBSERVATION WELLS	None apparent.	
WEIRS	None apparent.	
PIEZOMETERS	None apparent.	
OTHER	None apparent.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle, wooded.	
SEDIMENTATION	No visible evidence of significant sedimentation.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Channel is same width as spillway apron. Trees and brush overhang channel. Two 6-inch trees have fallen across channel.	Two trees should be removed from channel.
SLOPES	Gentle to flat. Wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	Two homes, estimated population 6, located downstream of Florence Avenue.	Possible appreciable property damage. Loss of life unlikely.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	copy on file at New Jersey Department of Environmental Protection
REGIONAL VICINITY MAP	prepared for this report
CONSTRUCTION HISTORY	none disclosed
TYPICAL SECTIONS OF DAM	copy on file at New Jersey Department of Environmental Protection
HYDROLOGIC/HYDRAULIC DATA	on file at New Jersey Department of Environmental Protection
OUTLETS - PLAN	copy on file at New Jersey Department of Environmental Protection
- DETAILS	copy on file at New Jersey Department of Environmental Protection
- CONSTRAINTS	copy on file at New Jersey Department of Environmental Protection
- DISCHARGE RATINGS	none disclosed
RAINFALL/RESERVOIR RECORDS	none disclosed

ITEM	REMARKS
DESIGN REPORTS	copies on file at New Jersey Department of Environmental Protection
GEOLOGY REPORTS	none disclosed
DESIGN COMPUTATIONS	on file at New Jersey Department of Environmental Protection
HYDROLOGY & HYDRAULICS	
DAM STABILITY	none disclosed
SEEPAGE STUDIES	none disclosed
MATERIALS INVESTIGATIONS	none disclosed
BORING RECORDS	
LABORATORY	
FIELD	
POST-CONSTRUCTION SURVEYS OF DAM	none disclosed
BORROW SOURCES	unknown

ITEM	REMARKS
MONITORING SERVICES	none
MODIFICATIONS	spillway repaired in 1949 concrete added to spillway in 1970's
HIGH POOL RECORDS	none disclosed
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	determination of spillway capacity for current spillway (1949) on file at New Jersey Department of Environmental Protection
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	overtopped in 1947, dam repaired and spillway replaced reports on file at New Jersey Department of Environmental Protection
MAINTENANCE OPERATION RECORDS	none disclosed

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	copies on file at New Jersey Department of Environmental Protection
DETAILS	copies on file at New Jersey Department of Environmental Protection
OPERATING EQUIPMENT	gate valve
PLANS & DETAILS	copies on file at New Jersey Department of Environmental Protection

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: .87 square miles; wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 521.1 (174 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 523.6 (215 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 524.7

ELEVATION TOP DAM: Low pt. 523.6, High pt. 525.2

CREST: free overflow concrete spillway

a. Elevation 521.1

b. Type concrete weir

c. Width 10'

d. Length 39'

e. Location Spillover approximate center of dam

f. Number and Type of Gates none

OUTLET WORKS: low-level outlet pipe

a. Type gate valve, part 12" CIP and part 12" concrete pipe

b. Location left of center of spillway

c. Entrance Inverts 515.6 (estimated)

d. Exit Inverts 514.4

e. Emergency Draindown Facilities none

HYDROMETEORLOGICAL GAGES: none

a. Type

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 579 cfs

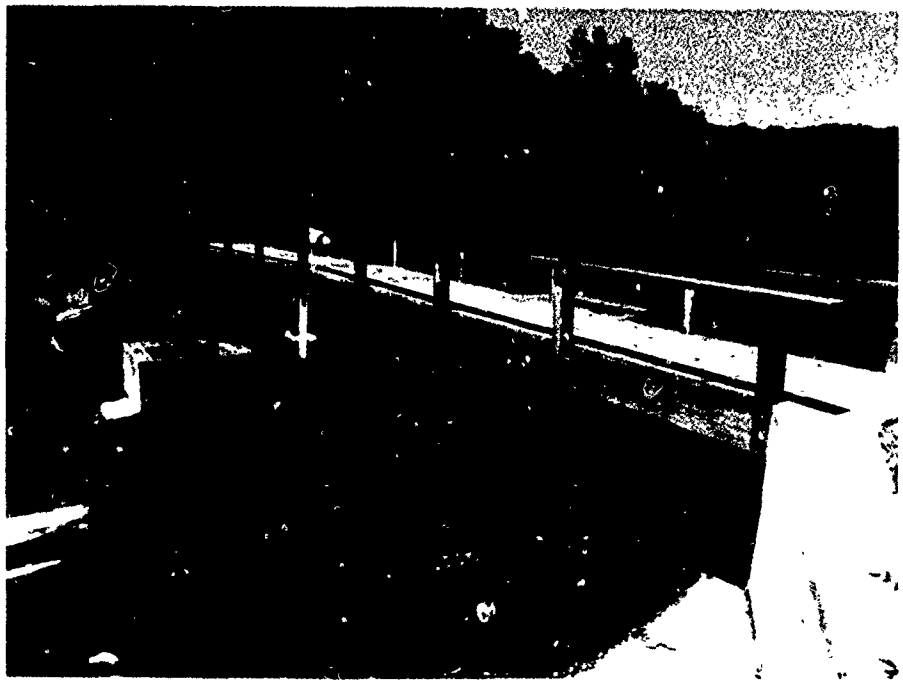
APPENDIX 3

PHOTOGRAPHS

ROCK RIDGE LAKE DAM

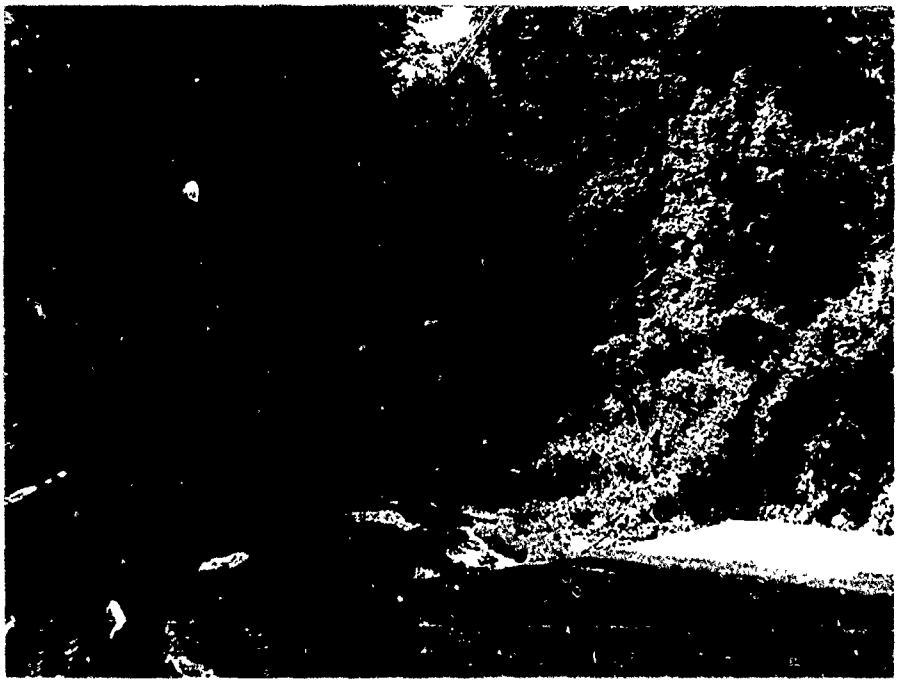
17 MAY 1979

VIEW FROM LEFT SIDE OF LAKE LOOKING TOWARDS SPILLWAY



17 MAY 1979

VIEW FROM LEFT SPILLWAY ABUTMENT LOOKING AT SPILLWAY CREST AND SERVICE BRIDGE



17 MAY 1979

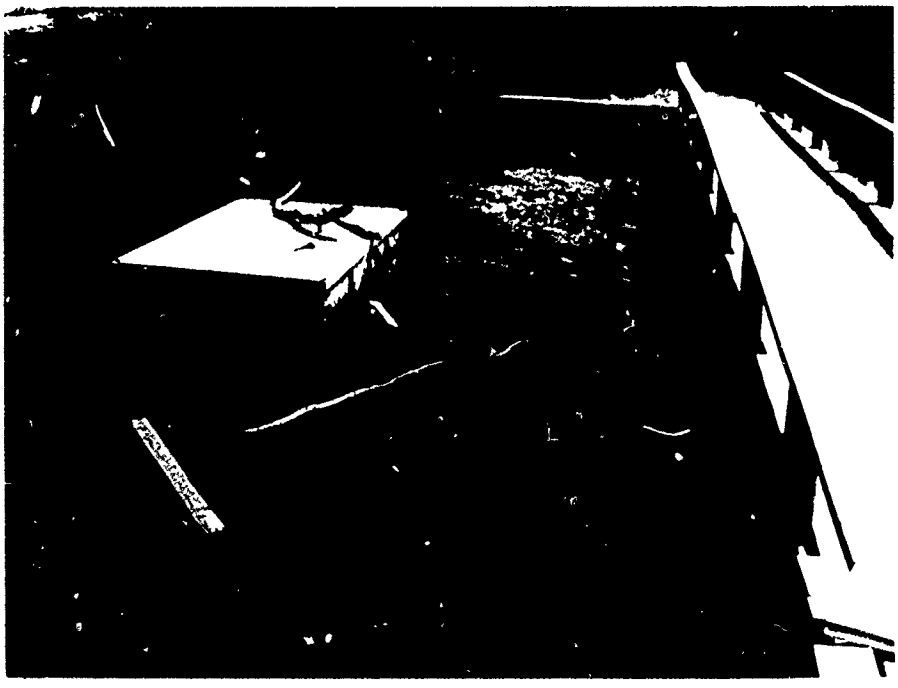
VIEW OF DOWNSTREAM CHANNEL

17 MAY 1979

VIEW UPSTREAM FROM CENTER OF SPILLWAY

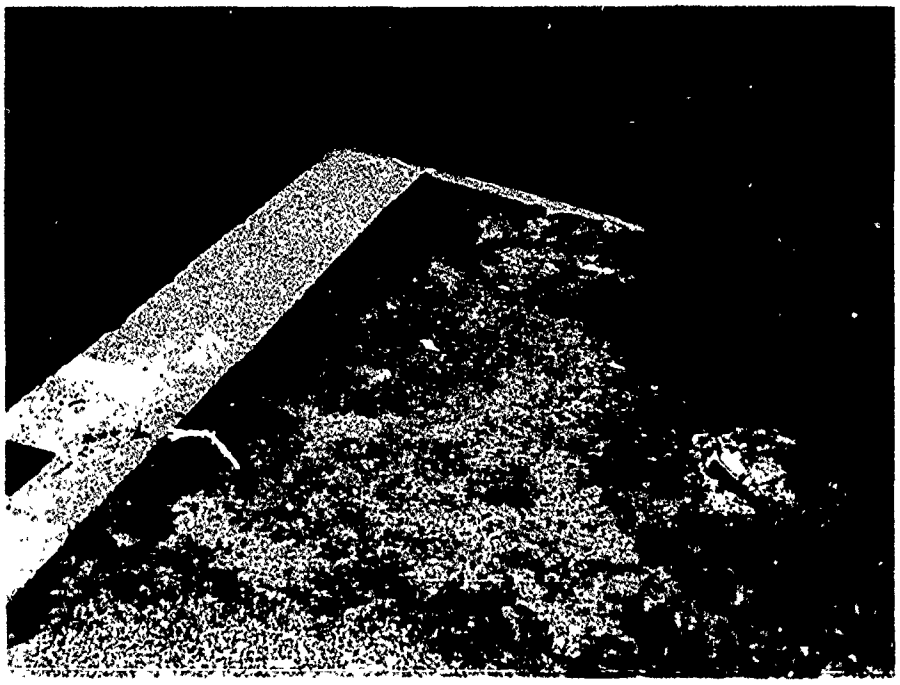
17 MAY 1979

VIEW OF DOWNSTREAM FACE OF SPILLWAY SHOWING OUTLET PIPE



17 MAY 1979

VIEW LOOKING NORTHEAST ACROSS SPILLWAY APRON UPSTREAM OF SERVICE BRIDGE

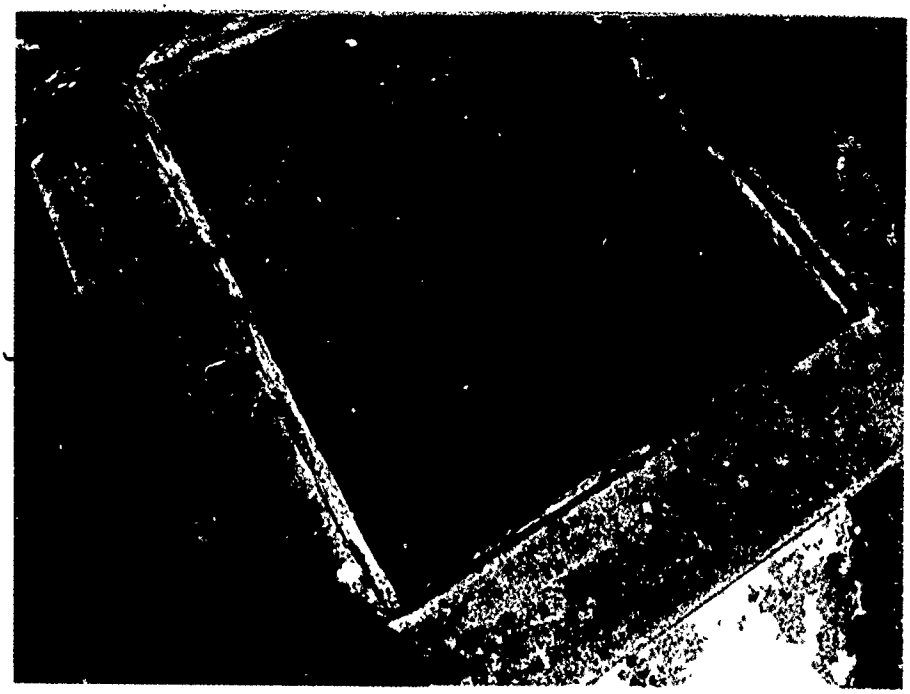


17 MAY 1979

EROSION NEXT TO LEFT TRAINING WALL (SIMILAR EROSION AT RIGHT TRAINING WALL)

17 MAY 1979

VIEW OF DOWNSTREAM PORTION OF SPILLWAY LOOKING NORTHEAST



17 MAY 1979

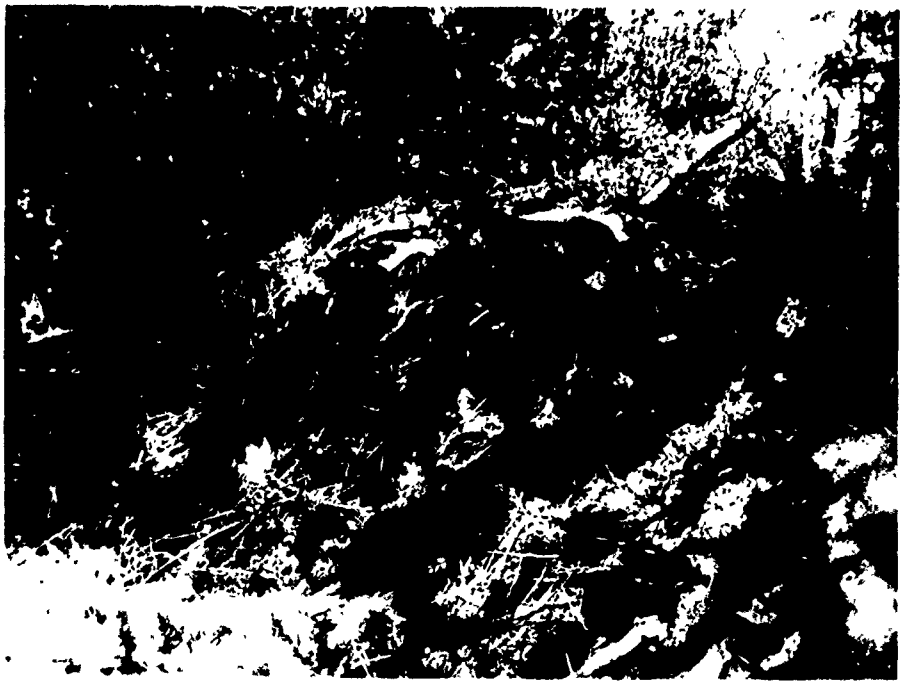
VIEW OF VALVE BOX

17 MAY 1979

VIEW OF RETAINING WALL AT LEFT OF SPILLWAY

17 MAY 1979

VIEW LOOKING SOUTHWEST ALONG CREST OF DAM FROM RIGHT SPILLWAY ABUTMENT TOWARDS THE RIGHT ABUTMENT



17 MAY 1979

BRUSH AND DEBRIS ON DOWNSTREAM FACE OF DAM NEAR RIGHT ABUTMENT

17 MAY 1979

VIEW OF DENNEY POND

APPENDIX 4

HYDROLOGIC COMPUTATIONS

ROCK RIDGE LAKE DAM

SQUARES 1/4 IN. SCALE

HYDROLOGIC COMPUTATIONS

NAME: ROCK RIDGE LAKE DAM

LOCATION: MORRIS COUNTY, NJ

DRAINAGE AREA: .87 mi^2

SURFACE AREA (NORMAL POOL): 17.4 ACRES

EVALUATION CRITERIA: SIZE: SMALL
HAZARD: SIGNIFICANT

SPILLWAY DESIGN FLOOD: BASED ON SIZE AND HAZARD CLASSIFICATION, THE SPILLWAY DESIGN FLOOD WILL BE THE ½PMF (1/2 THE PROBABLE MAXIMUM FLOOD), WITH A PEAK INFLOW OF 2476 CFS.

NOTE: DRAINAGE AREA AND SURFACE AREA OF ROCK RIDGE LAKE WERE PLANNIMETERED DUE TO DISCREPANCIES IN REPORTED AREAS. D.A. WAS VARIOUSLY REPORTED AS 0.84 mi^2 AND 1.25 mi^2; S.A. WAS VARIOUSLY REPORTED TO BE 20.5 ACRES AND 30 ACRES

Anderson-Nichols & Company, Inc.

Subject ROCK RIDGE

Sheet No. 2 of 11
Date 2/20/79
Computed KATE
Checked

JOB NO. 3290-01

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DETERMINE TIME OF CONCENTRATION

REACH 1 OVERLAND FLOW, WOODED
LENGTH = 1350'
HEAD = 20'

A, BY KIRPICH NOMOGRAPH $T_c = 10$ mins

B. BY IZZARDS FORMULA $T_c = \frac{L_{FT}^{1.115}}{(7700)(H_{FT}^{.38})}$

$T_c = \frac{1350^{1.115}}{(7700)(20^{.38})} = .13$ hrs $= 7.8$ mins

C BY CALIFORNIA CULVERT EQUATION

$T_c = \left[\frac{(11.9)(L_{mi}^3)}{H_{FT}}\right]^{.385}$

$= \left[\frac{(11.9)(.256^3)}{20}\right]^{.385} = .17$ hrs $= 10.2$ mins

D. BY WESTON FORMULA $T_c = \frac{L_{FT}}{(3600)V}$
WHERE V = VELOCITY
DERIVED FROM NAVY TABLE P.70 DESIGN OF SMALL DAMS

$T_c = \frac{1350}{3600(2)} = .19$ hrs $= 11.4$ mins

AVG T_c REACH 1 $= (10 + 7.8 + 10.2 + 11.4) \div 4 = 9.9$ mins

REACH 2 CHANNEL FLOW
LENGTH = 9300'
HEAD = 100'

A. BY KIRPICH NOMOGRAPH $T_c = 51$ mins

B. BY IZZARDS FORMULA $T_c = \frac{L_{FT}^{1.115}}{7700(H_{FT}^{.35})}$

$T_c = \frac{9300^{1.115}}{7700(100^{.35})} = .6$ hrs $= 36$ mins

SQUARES 1/4 IN. SCALE

REACH 2 CONTINUED:

C. BY CALIFORNIA CULVERT EQUATION:

$$T_c = \left[\frac{11.9 (L_{MI}^3)}{H_{FT}}\right]^{.385}$$

$$T_c = \left[\frac{(11.9)(1.76^3)}{100}\right]^{.385} = .85 \text{ hrs} = 51 \text{ mins}$$

D. BY WESTON FORMULA: $T_c = \frac{L_{FT}}{3600(V)}$

WHERE V = VELOCITY

DERIVED FROM USAM TABLE P. 70 DESIGN OF SMALL DAMS

$$T_c = \frac{9300}{3600(2)} = 1.3 \text{ hrs} = 78 \text{ mins}$$

AVG T_c REACH 2 = (51+36+51+78)÷4 = 54 mins

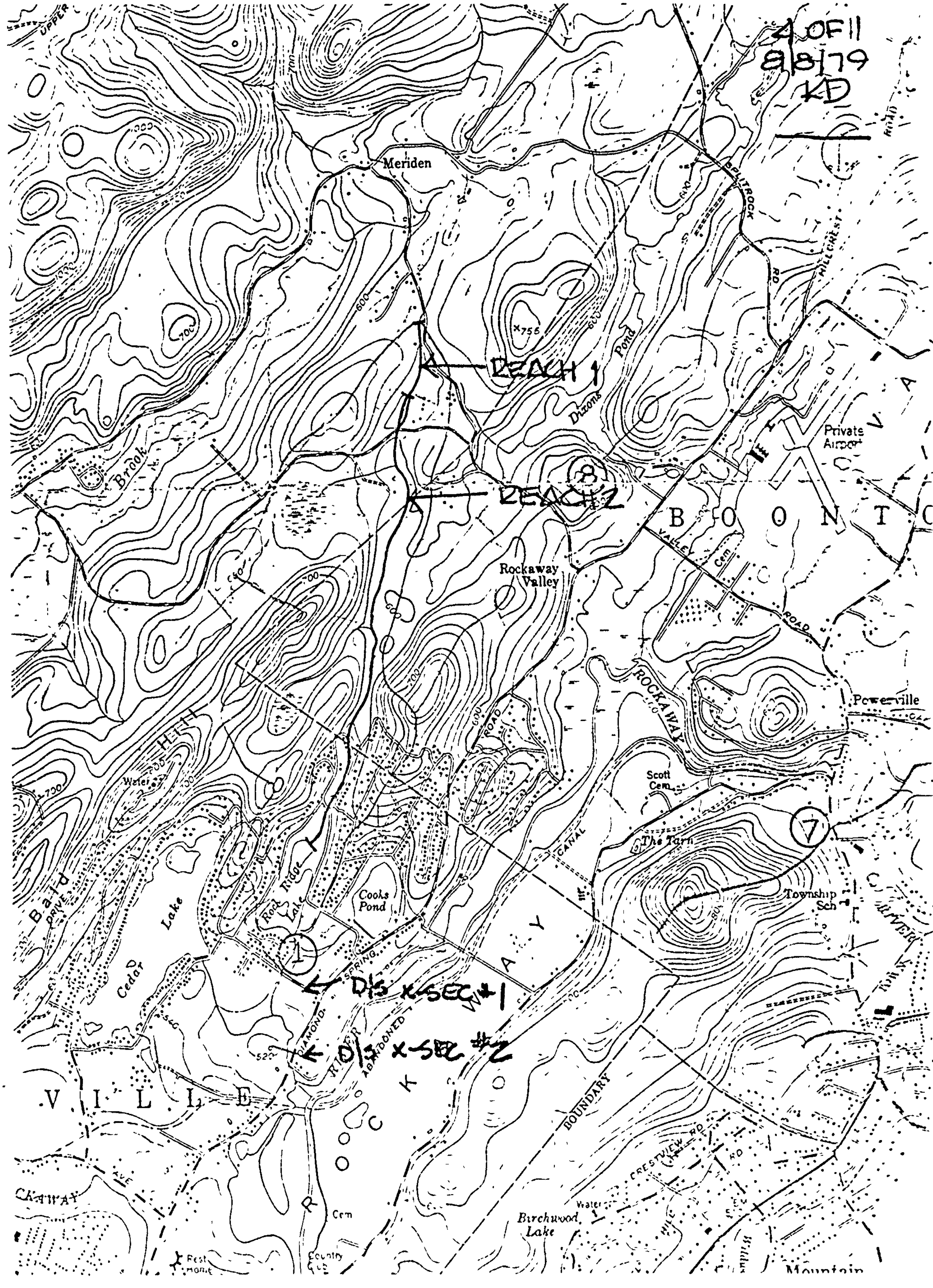
T_c TOTAL = T_c REACH 1 + T_c REACH 2

= 9.9 + 54

= 63.9 mins

LAG = .6 [TC] = (.6)(63.9) = 38.3 mins

= .64 hrs


4 OF 11
8/8/79
KD
Meriden
REACH 1
REACH 2
Dixons Pond
Private Airport
B O O N T
Rockaway Valley
Powerville
Scott Cem
The Tarn
Township Sch
Cooks Pond
Rock Ridge Lake
Cedar Lake
D/S X-SEC #1
D/S X-SEC #2
V I L L E
BOUNDARY
CRESTVIEW RD
Birchwood Lake
Mountain
Brook
CANAL
ROCKAWAY

Anderson-Nichols & Company, Inc.

Subject ROCK RIDGE LAKE

Sheet No. 5 of 11

Date 8/6/79

Computed KD

Checked EDD

JOB NO. 3290-01

DEVELOPMENT OF RATING CURVE

① SPILLWAY CURVE

A. COMPUTE Q USING WEIR FLOW EQUATION ($Q=CLH^{3.2}$) TO BEAM, THEN PRESSURE FLOW ($Q=CA\sqrt{2gH}$) FROM 522.9 TO 523.6 (BRIDGE), THEN WEIR FLOW EQUATION AGAIN

B. WEIR COEFFICIENT 2.64 (TAKEN FROM 1949 CCCS)
ORIFICE COEFFICIENTS: .65 (TABLE 4-5 KING & BRATER)

C. EFFECTIVE LENGTH SPILLWAY: 39'

D. A = AREA UNDER BRIDGE = 70.2 SQ FT

E H = HEAD (FT)

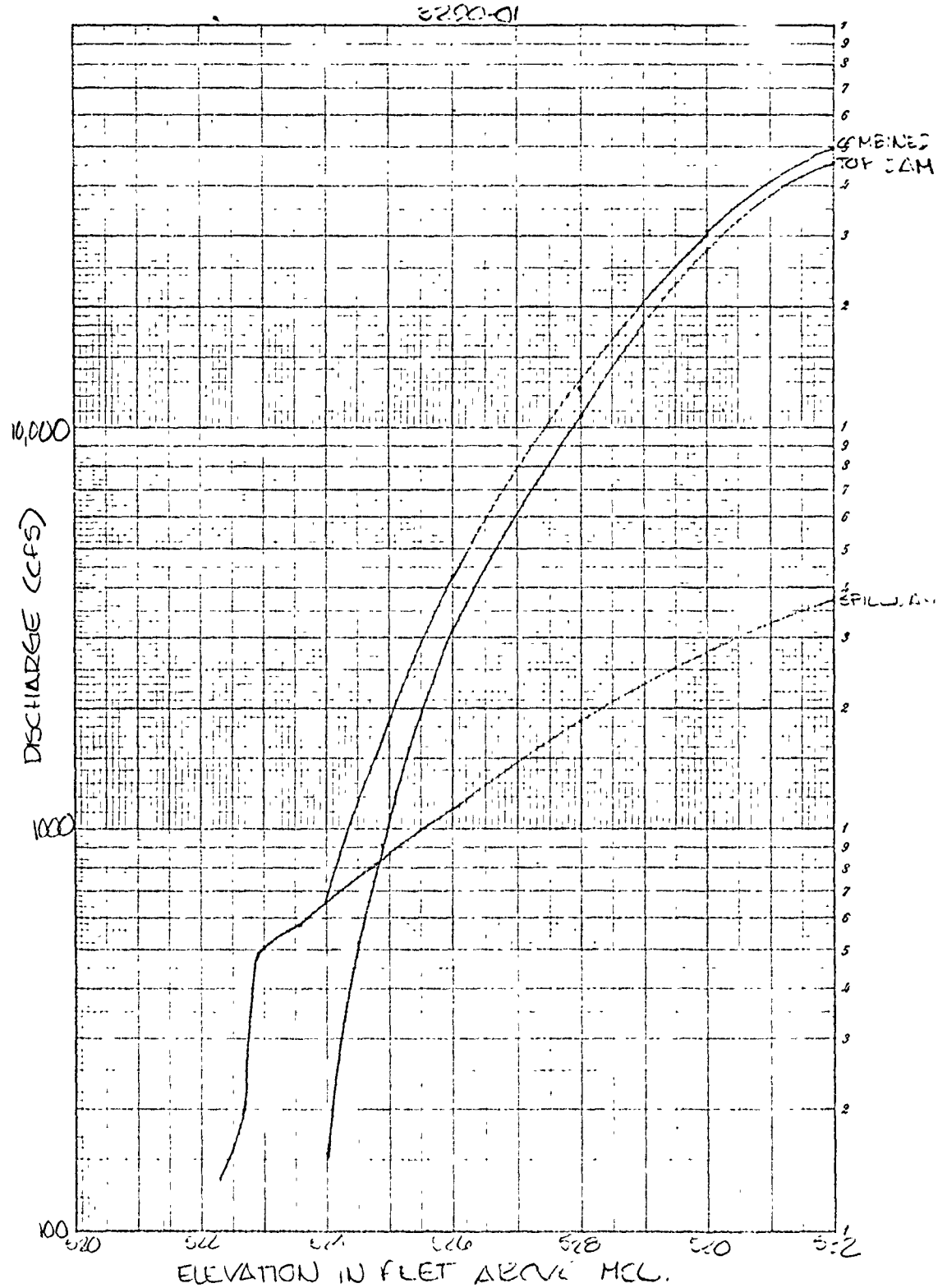
② TOP DAM

A. COMPUTE Q USING WEIR FLOW EQUATION

B WEIR COEFFICIENT = 2.6

ELEVATION FT	SPILLWAY HEAD FT	SPILLWAY Q CFS	TOP DAM HEAD FT	TOP DAM LENGTH FT	TOP DAM Q CFS	COMBINED Q CFS
521.1	0	0				0
521.5	.4	26				26
521.9	.8	74				74
522.3	1.2	135				135
522.7	1.6	208				208
522.9	1.8	491				491
523.3	2.2	543				543
523.6	2.5	579	0	235	0	579
524	2.9	508	.4	225	155	663
524.9	3.8	763	1.3	225	906	1669
526	4.9	1117	2.4	225	3142	4259
528	6.9	1866	4.4	450	10,799	12,665
530	8.9	2734	6.4	650	27,363	30,097
532	10.9	3705	8.4	720	45,575	49,280

ROCK RIDGE LAKE DAM
COMBINED RATING CURVE
E250-01



Anderson-Nichols & Company, Inc.

Subject ROCK RIDGE

Sheet No. 7 of 11
Date 6/14/79
Computed K.L.E.
Checked EDD

JOB NO. 3290-01

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

STAGE-STORAGE DETERMINATIONS

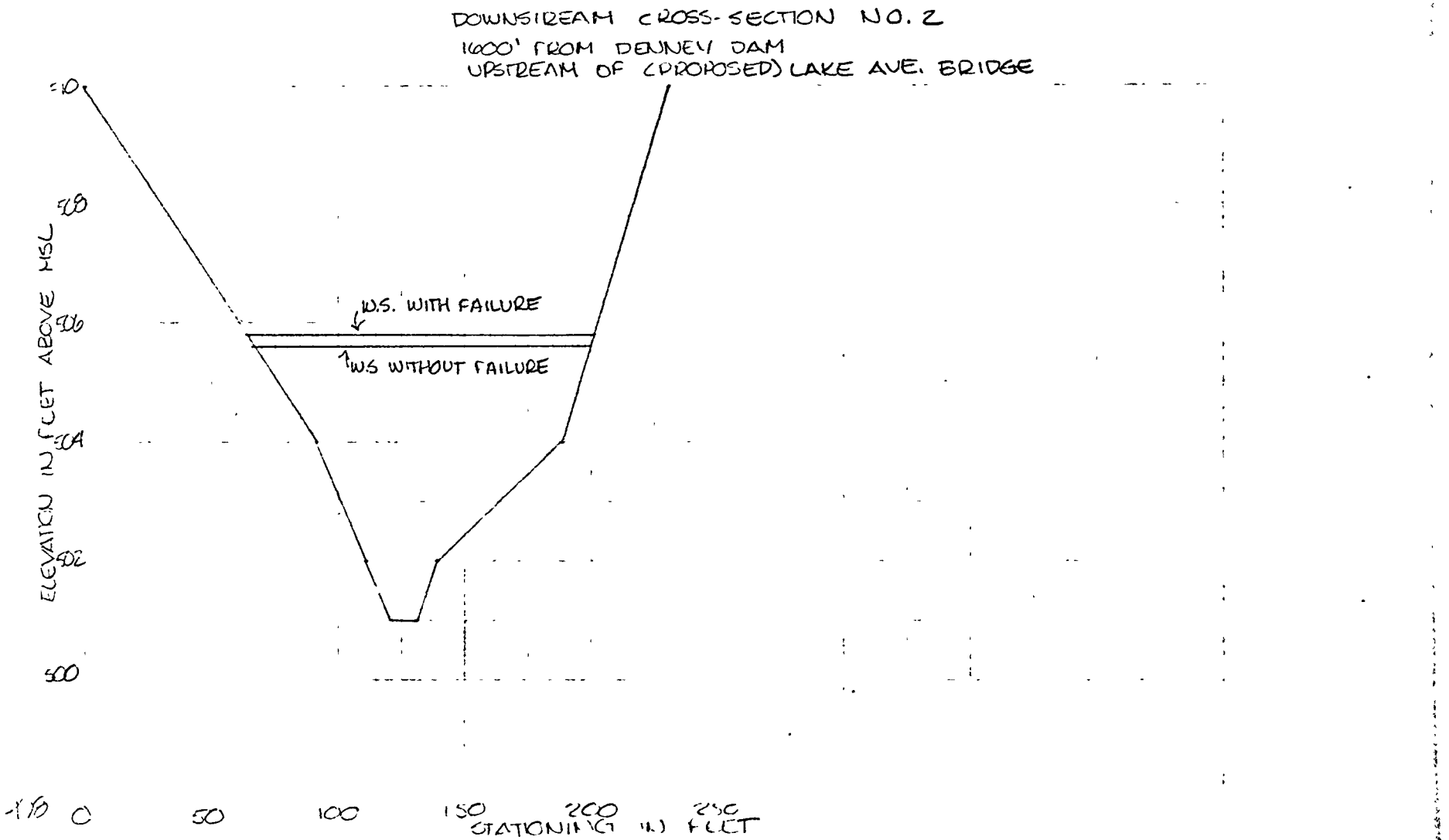
TAKE DEPTH OF LAKE TO BE 10'

ELEVATION FT	SURFACE AREA ACRES	AVG. S.A. ACRES	INCREMENTAL STORAGE AC-FT	CUMULATIVE STORAGE AC-FT
521.1	17.4	17.4	174	174
540	48.2	32.8	620	794
560	76.7	62.5	1250	2044

INPUT FOR HCC-1 (FROM CURVE)

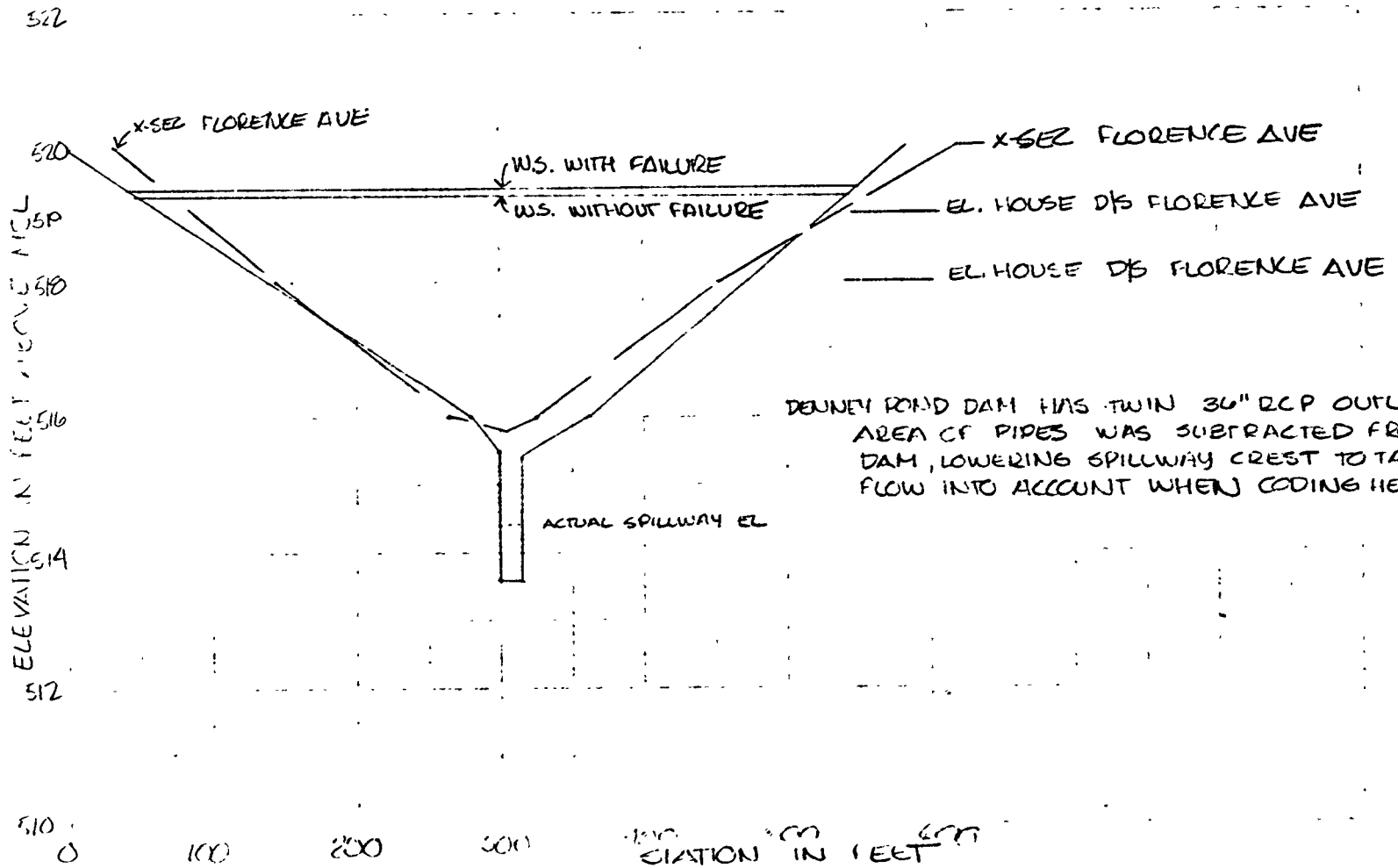
STAGE	STORAGE
511.1	0
521.1	174
523.6	218
526	272
528	320
530	379
535	561
540	794
545	1080
550	1395
560	2044

ROCK RIDGE LAKE DAM
STORAGE - ELEVATION CURVE


DOWNSTREAM CROSS-SECTION NO. 2
1600' FROM DENNEY DAM
UPSTREAM OF (PROPOSED) LAKE AVE. BRIDGE
ELEVATION IN FEET ABOVE MSL
W.S. WITH FAILURE
W.S WITHOUT FAILURE
STATIONING IN FEET
0
50
100
150
200
250

C

D/S CROSS-SECTION NO 1
AT DENNEY DAM



DENNEY POND DAM HAS TWIN 36" RCP OUTLET. AREA OF PIPES WAS SUBTRACTED FROM DAM, LOWERING SPILLWAY CREST TO TAKE FLOW INTO ACCOUNT WHEN CODING HEC 1

Anderson-Nichols & Company, Inc.

Subject DOCK RIDGE LAKE DAM Sheet No. 9 of 11

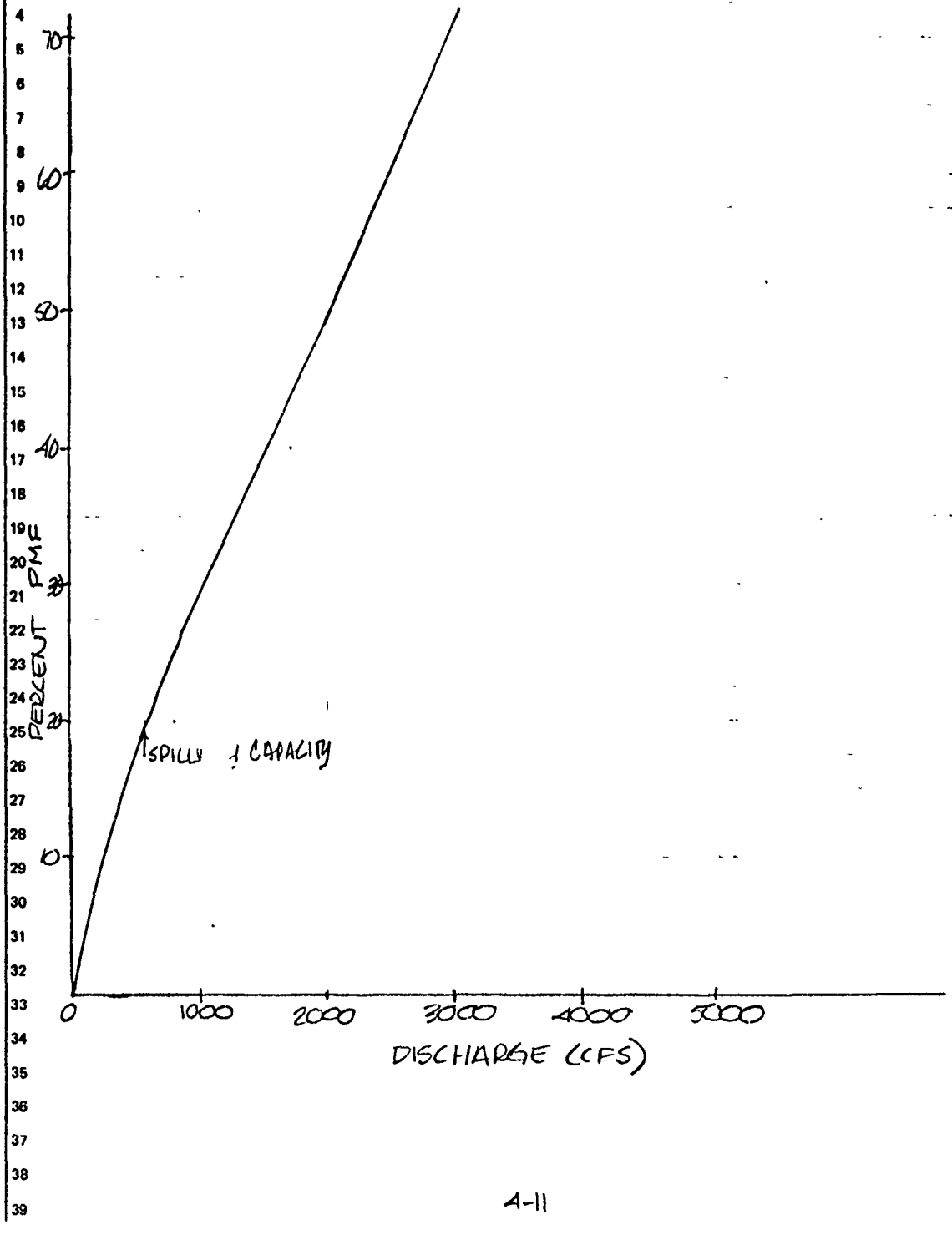
JOB NO. 3290-01 Date 6/25/79

Computed KAE

Checked EJ

SQUARES 1/4 IN. SCALE

OVERTOPPING POTENTIAL



SQUARES 1/4 IN. SCALE

DETERMINATION OF "C" FOR LOW-LEVEL OUTLET

D = DIAMETER = 12" CIP OR 1.0' CIP

N = .015 (SOIL & WATER CONSERVATION ENGINEERING p. 632)

A_p = AREA OF PIPE OPENING = .79 SQ. FT.

L_p = LENGTH PIPE = 72'

K_F = FRICTION LOSS THROUGH PIPE

K_L = ENTRANCE LOSS OF PIPE = .8 (IBID p. 639)

C_p = COEFFICIENT OF DISCHARGE (INCORPORATING A_p & 2g)

C = COEFFICIENT OF DISCHARGE

$$K_F = \frac{5087\, n^2}{D^{5.3}} = \frac{5087\,(.015)^2}{12^{1.333}} = \frac{1.14}{27.45} = .042$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_L + K_F L_p}}$$

$$= .79 \sqrt{\frac{64.4}{1 + .8 + (.042)(72)}}$$

$$= 2.89$$

$$C = \frac{2.89}{\frac{.79}{\sqrt{61.1}}}$$

$$\therefore C = .46$$

Anderson-Nichols & Company, Inc.

Subject ROCK RIDGE LAKE DAM

Sheet No. 11 of 11
Date 6/26/79 8/15/79
Computed RATE
Checked FDJ

JOB NO. 3290-01

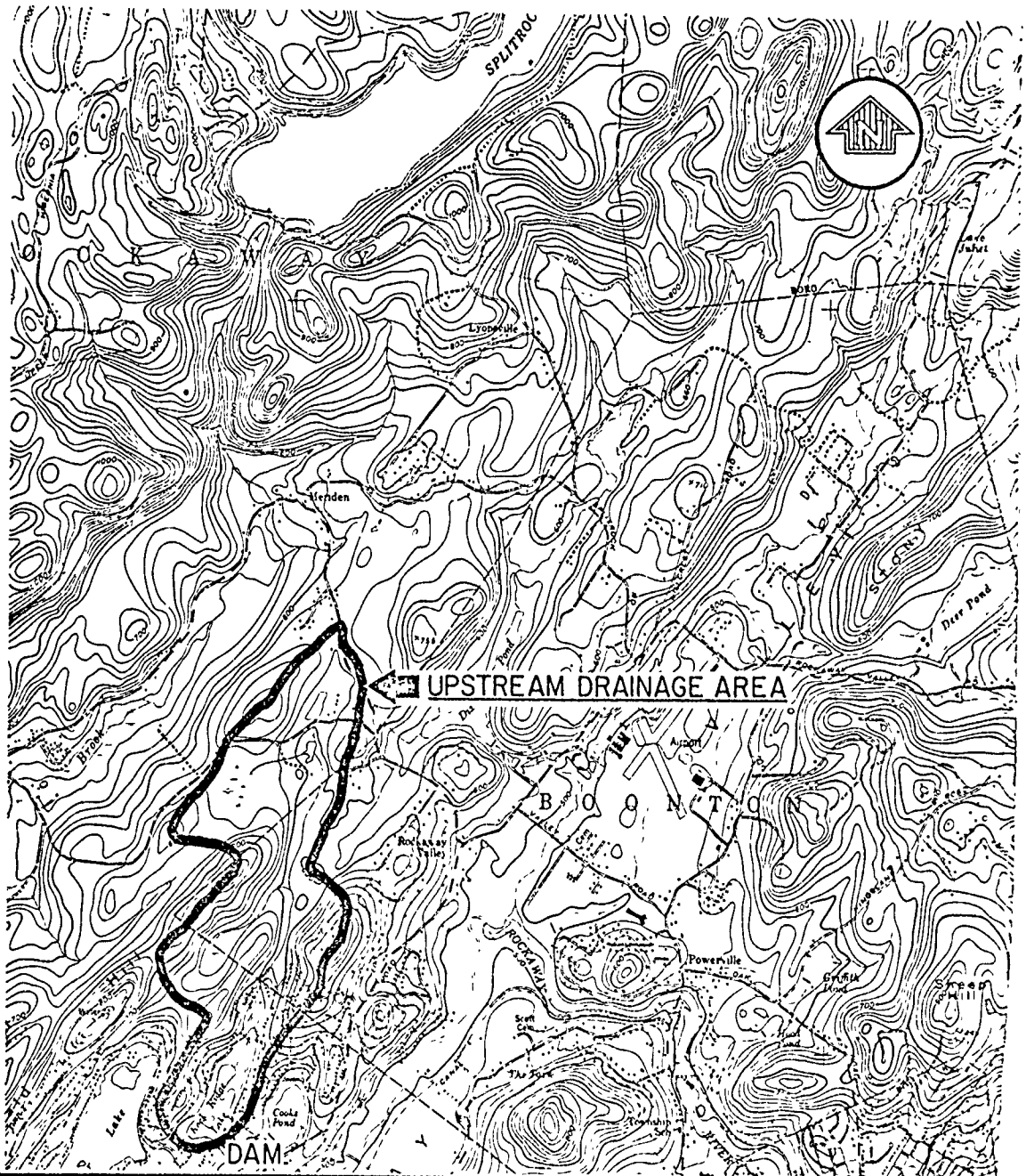
SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DRAWDOWN CALCULATIONS

CALCULATIONS ASSUME ① NO SIGNIFICANT INFLOW
② LOW LEVEL OUTLET TO BE OPERABLE
③ INVERT U/S SAME AS INVERT AT GATE = 515.6
④ $Q_p = C_p H^{1/2} = 2.89 H^{1/2}$ (SEE PREVIOUS PAGE)
⑤ AC-FT-DAY = 1.9835 (AVG Q)
⑥ DAYS = Δ STORAGE / AC-FT-DAY

ELEV. FT.	STORAGE AC-FT	ΔSTORAGE AC-FT	H FT	Q CFS	AVG Q CFS	AC-FT PER DAY	DAYS
521.1	174		5.5	6.78			
		10			6.62	13.13	0.76
520.6	164		5	6.46			
		10			6.31	12.52	0.80
520.1	154		4.5	6.13			
		9			5.96	11.82	0.76
519.6	145		4	5.78			
		9			5.60	11.11	0.81
519.1	136		3.5	5.41			
		9			5.21	10.33	0.87
518.6	127		3	5.01			
		9			4.79	9.50	0.95
518.1	118		2.5	4.57			
		9			4.33	8.59	1.05
517.6	109		2	4.09			
		8			3.82	7.58	1.06
517.1	101		1.5	3.54			
		8			3.22	6.39	1.25
516.6	93		1	2.89			
		8			2.47	4.90	1.63
516.1	85		.5	2.04			
		7			1.02	2.02	3.47
515.6	78		0	0			

TOTAL = 13.41



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

ROCK RIDGE LAKE DAM
DENVILLE TOWNSHIP, NEW JERSEY

REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC. BOSTON, MA

SCALE IN MILES

0 1/2 1 2

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEET. BOONTON, N.J., 1954, UPDATED 1970.

HEC-1 OUTPUT

OVERTOPPING ANALYSIS

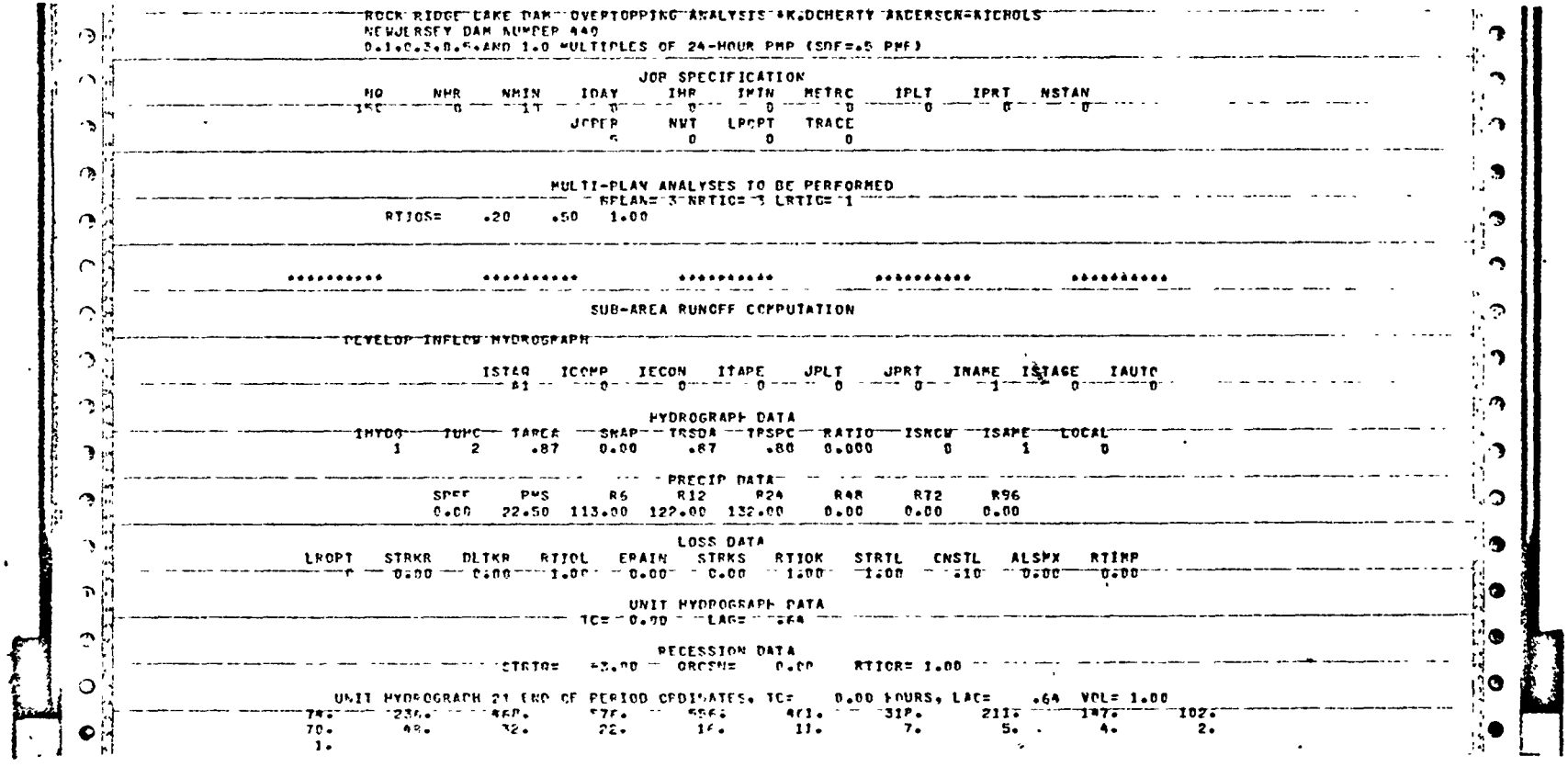
ROCK RIDGE LAKE DAM

ROCK RIDGE 1

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
 LAST MODIFICATION  26 FEB 79
**********
     1          A1 ROCK RIDGE LAKE DAM  OVERTOPPING ANALYSIS  M.DOHERTY ANDERSON-NICHOLS
     2          A2 NEWJERSEY DAM NUMBER 460
     3          A3 0.1+0.3+0.5+AND 1.0 MULTIPLES OF 24-HOUR PMP (SDF=.5 PMF)
     4          R    150       0      10       0       0       0       0       0       0       0
     5          R1     5
     6          J      3       3       1
     7          J1   0.2     0.5     1.0
     8          K      0      A1                                       1
     9          K1 DEVELOP INFLOW HYDROGRAPH
    10          P      1       2     .87                       .8                      1
    11          P             22.5     113.    122.    132.
    12          T                                                  1.      .1
    13          U2           .66
    14          X     -3.
    15          K      1      A2                                       1
    16          K1 ROUTE  INFLOW HYDROGRAPH THROUGH IMPOUNDMENT
    17          Y                                      1       1
    18          Y1     1                                                174.      -1
    19          Y4 521.1   521.5   521.9   522.3   522.7   522.9   523.3   523.6    524.    524.9
    20          Y4   526.    528.    530.    532.
    21          Y5     0.      26.     74.    135.    208.    491.    543.    579.    663.   1669.
    22          Y5  4759.   12665.  30097.  49280.
    23          $S     0     174.    218.    272.    320.    379.    560.    794.   1080.   1395.
    24          $S  2044.
    25          $E 511.1   521.1   523.6   526.    528.    530.    535.    540.    545.    550.
    26          $F   560.
    27          $$ 521.1
    28          $D 523.6
    29          $B  10.2       1   513.6      .5   521.1    550.
    30          $B  10.2       1   513.6      1.   521.1   523.6
    31          $B  10.2       1   513.6      2.   521.1   523.6
    32          K      1      A3                                       1
    33          K1 CHANNEL ROUTING -MOD PULS- REACH 1
    34          Y                                      1       1
    35          Y1     1
    36          Y6   .070    .030    .070   513.6    520.    830.    .002
    37          Y7     0.    520.    260.    516.    299.   513.4    300.   513.6    315.   513.6
    38          Y7   316.   515.4    362.    516.    584.    520.
    39          K      1      A4                                       1
    40          K1 CHANNEL ROUTING -MOD PULS- REACH 2
    41          Y                                      1       1
    42          Y1     1
    43          Y6   .070    .030    .070    501.    510.   1600.   .0075
    44          Y7     0.    510.     92.    504.    112.    502.    122.    501.    132.    501.
    45          Y7   139.    502.    188.    504.    232.    510.
    46          K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          A1
ROUTE HYDROGRAPH TO           A2
ROUTE HYDROGRAPH TO           A3
ROUTE HYDROGRAPH TO           A4
END OF NETWORK
```



ROCK RIDGE LAKE DAM OVERTOPPING ANALYSIS *K.DOHERTY ANDERSON-NICHOLS
NEWJERSEY DAM NUMBER 440
0.1*0.3*0.5*AND 1.0 MULTIPLES OF 24-HOUR PMP (SDF=.5 PMF)

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	17	0	0	0	0	0	0	0

JCOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 3 NRTIO= 3 LRTIO= 1
RTIOS= .20 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
81	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDO	IUHC	TAREA	SNAP	TRSDA	TPSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.87	0.00	.87	.80	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	113.00	122.00	132.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .64

RECESSION DATA
STRTQ= -3.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 21 END-OF-PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .64 VOL= 1.00

74.	236.	468.	576.	556.	461.	318.	211.	147.	102.
70.	48.	32.	22.	16.	11.	7.	5.	4.	2.
1.									

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.02	0.00	.02	3.
1.01	.20	2	.02	0.00	.02	3.
1.01	.30	3	.02	0.00	.02	3.
1.01	.40	4	.02	0.00	.02	3.
1.01	.50	5	.02	0.00	.02	3.
1.01	1.00	6	.02	0.00	.02	3.
1.01	1.10	7	.02	0.00	.02	3.
1.01	1.20	8	.02	0.00	.02	3.
1.01	1.30	9	.02	0.00	.02	3.
1.01	1.40	10	.02	0.00	.02	3.
1.01	1.50	11	.02	0.00	.02	3.
1.01	2.00	12	.02	0.00	.02	3.
1.01	2.10	13	.02	0.00	.02	3.
1.01	2.20	14	.02	0.00	.02	3.
1.01	2.30	15	.02	0.00	.02	3.
1.01	2.40	16	.02	0.00	.02	3.
1.01	2.50	17	.02	0.00	.02	3.
1.01	3.00	18	.02	0.00	.02	3.
1.01	3.10	19	.02	0.00	.02	3.
1.01	3.20	20	.02	0.00	.02	3.
1.01	3.30	21	.02	0.00	.02	3.
1.01	3.40	22	.02	0.00	.02	3.
1.01	3.50	23	.02	0.00	.02	3.
1.01	4.00	24	.02	0.00	.02	3.
1.01	4.10	25	.02	0.00	.02	3.
1.01	4.20	26	.02	0.00	.02	3.
1.01	4.30	27	.02	0.00	.02	3.
1.01	4.40	28	.02	0.00	.02	3.
1.01	4.50	29	.02	0.00	.02	3.
1.01	5.00	30	.02	0.00	.02	3.
1.01	5.10	31	.02	0.00	.02	3.
1.01	5.20	32	.02	0.00	.02	3.
1.01	5.30	33	.02	0.00	.02	3.
1.01	5.40	34	.02	0.00	.02	3.
1.01	5.50	35	.02	0.00	.02	3.
1.01	6.00	36	.02	0.00	.02	3.
1.01	6.10	37	.05	0.00	.05	3.
1.01	6.20	38	.05	0.00	.05	3.
1.01	6.30	39	.05	0.00	.05	3.
1.01	6.40	40	.05	0.00	.05	3.
1.01	6.50	41	.05	0.00	.05	3.
1.01	7.00	42	.05	0.00	.05	3.
1.01	7.10	43	.05	.02	.02	4.
1.01	7.20	44	.05	.03	.02	10.
1.01	7.30	45	.05	.03	.02	22.
1.01	7.40	46	.05	.03	.02	37.
1.01	7.50	47	.05	.03	.02	53.
1.01	8.00	48	.05	.03	.02	67.
1.01	8.10	49	.05	.03	.02	77.
1.01	8.20	50	.05	.03	.02	83.
1.01	8.30	51	.05	.03	.02	88.
1.01	8.40	52	.05	.03	.02	91.
1.01	8.50	53	.05	.03	.02	93.
1.01	9.00	54	.05	.03	.02	95.
1.01	9.10	55	.05	.03	.02	96.
1.01	9.20	56	.05	.03	.02	97.
1.01	9.30	57	.05	.03	.02	97.
1.01	12.40	76	.34	.32	.02	496.
1.01	12.50	77	.34	.32	.02	660.
1.01	13.00	78	.34	.32	.02	795.
1.01	13.10	79	.41	.39	.02	894.
1.01	13.20	80	.41	.39	.02	972.
1.01	13.30	81	.41	.39	.02	1047.
1.01	13.40	82	.41	.39	.02	1116.
1.01	13.50	83	.41	.39	.02	1174.
1.01	14.00	84	.41	.39	.02	1219.
1.01	14.10	85	.51	.49	.02	1258.
1.01	14.20	86	.51	.49	.02	1703.
1.01	14.30	87	.51	.49	.02	1365.
1.01	14.40	88	.51	.49	.02	1433.
1.01	14.50	89	.51	.49	.02	1497.
1.01	15.00	90	.51	.49	.02	1548.
1.01	15.10	91	.46	.45	.02	1581.
1.01	15.20	92	.77	.76	.02	1617.
1.01	15.30	93	1.39	1.37	.02	1731.
1.01	15.40	94	3.48	3.46	.02	2161.
1.01	15.50	95	1.00	.99	.02	2922.
1.01	16.00	96	.62	.60	.02	3797.
1.01	16.10	97	.47	.46	.02	4216.
1.01	16.20	98	.47	.46	.02	4114.
1.01	16.30	99	.47	.46	.02	3667.
1.01	16.40	100	.47	.46	.02	3064.
1.01	16.50	101	.47	.46	.02	2582.
1.01	17.00	102	.47	.46	.02	2260.
1.01	17.10	103	.37	.36	.02	2031.
1.01	17.20	104	.37	.36	.02	1852.
1.01	17.30	105	.37	.36	.02	1697.
1.01	17.40	106	.37	.36	.02	1565.
1.01	17.50	107	.37	.36	.02	1459.
1.01	18.00	108	.37	.36	.02	1379.
1.01	18.10	109	.03	.01	.02	1298.
1.01	18.20	110	.03	.01	.02	1179.
1.01	18.30	111	.03	.01	.02	993.
1.01	18.40	112	.03	.01	.02	777.
1.01	18.50	113	.03	.01	.02	572.
1.01	19.00	114	.03	.01	.02	404.
1.01	19.10	115	.03	.01	.02	288.
1.01	19.20	116	.03	.01	.02	212.
1.01	19.30	117	.03	.01	.02	160.
1.01	19.40	118	.03	.01	.02	124.
1.01	19.50	119	.03	.01	.02	100.
1.01	20.00	120	.03	.01	.02	83.
1.01	20.10	121	.03	.01	.02	71.
1.01	20.20	122	.03	.01	.02	63.
1.01	20.30	123	.03	.01	.02	58.
1.01	20.40	124	.03	.01	.02	54.
1.01	20.50	125	.03	.01	.02	52.
1.01	21.00	126	.03	.01	.02	50.
1.01	21.10	127	.03	.01	.02	49.
1.01	21.20	128	.03	.01	.02	48.
1.01	21.30	129	.03	.01	.02	48.
1.01	21.40	130	.03	.01	.02	48.
1.01	21.50	131	.03	.01	.02	48.
1.01	22.00	132	.03	.01	.02	48.

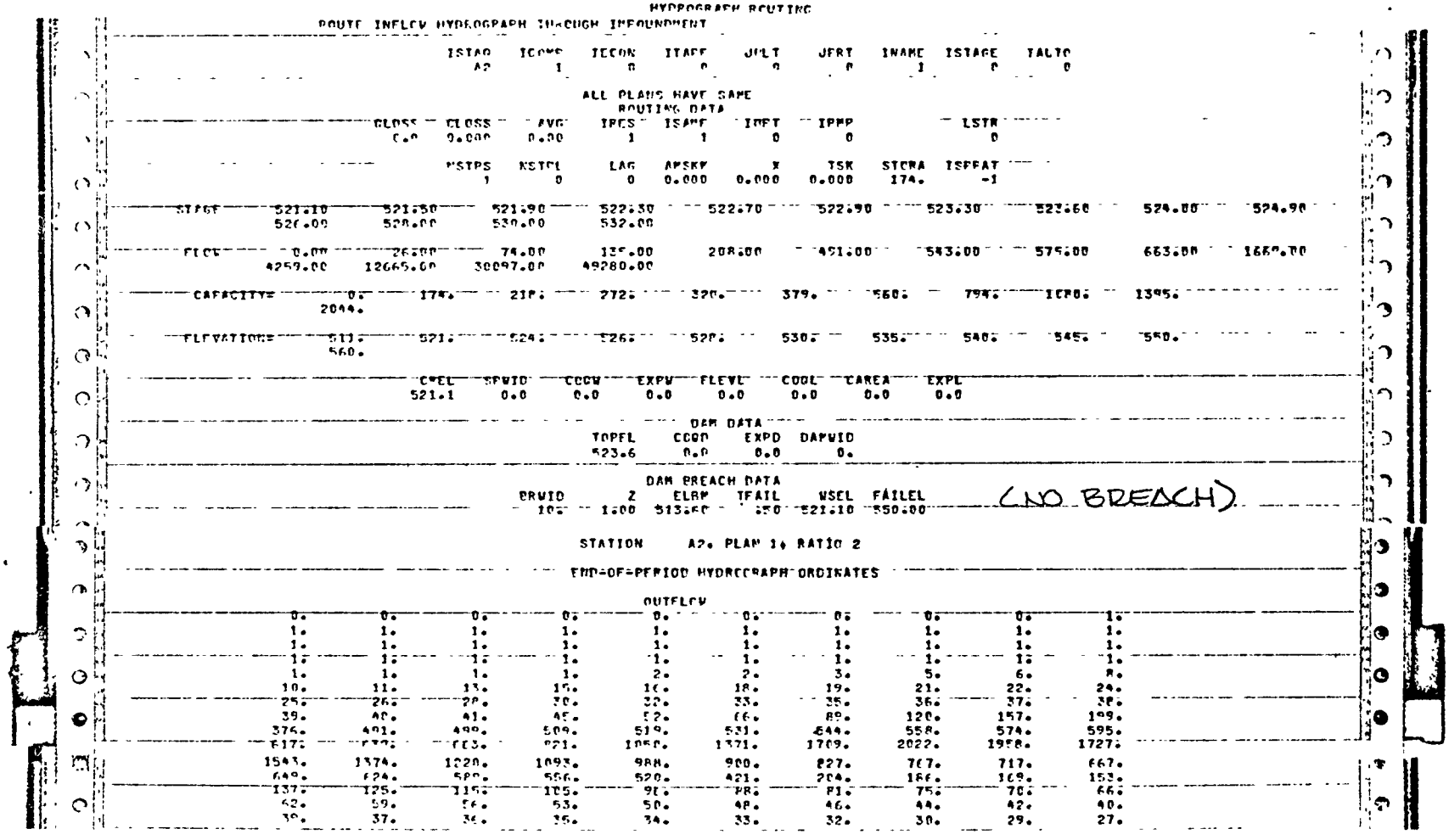
END OF PERIOD FLOW DATA CONTINUED

1.01	9.40	58	.05	.03	.02	97.	1.01	22.10	133	.03	.01	.02	48.
1.01	9.50	59	.05	.03	.02	98.	1.01	22.20	134	.03	.01	.02	48.
1.01	10.00	60	.05	.03	.02	98.	1.01	22.30	135	.03	.01	.02	48.
1.01	10.10	61	.05	.03	.02	98.	1.01	22.40	136	.03	.01	.02	48.
1.01	10.20	62	.05	.03	.02	98.	1.01	22.50	137	.03	.01	.02	48.
1.01	10.30	63	.05	.03	.02	98.	1.01	23.00	138	.03	.01	.02	48.
1.01	10.40	64	.05	.03	.02	98.	1.01	23.10	139	.03	.01	.02	48.
1.01	10.50	65	.05	.03	.02	98.	1.01	23.20	140	.03	.01	.02	48.
1.01	11.00	66	.05	.03	.02	98.	1.01	23.30	141	.03	.01	.02	48.
1.01	11.10	67	.05	.03	.02	98.	1.01	23.40	142	.03	.01	.02	48.
1.01	11.20	68	.05	.03	.02	98.	1.01	23.50	143	.03	.01	.02	48.
1.01	11.30	69	.05	.03	.02	98.	1.02	0.00	144	.03	.01	.02	48.
1.01	11.40	70	.05	.03	.02	96.	1.02	.10	145	0.00	0.00	0.00	47.
1.01	11.50	71	.05	.03	.02	98.	1.02	.20	146	0.00	0.00	0.00	43.
1.01	12.00	72	.05	.03	.02	98.	1.02	.30	147	0.00	0.00	0.00	37.
1.01	12.10	73	.34	.32	.02	120.	1.02	.40	148	0.00	0.00	0.00	29.
1.01	12.20	74	.34	.32	.02	189.	1.02	.50	149	0.00	0.00	0.00	22.
1.01	12.30	75	.34	.32	.02	327.	1.02	1.00	150	0.00	0.00	0.00	16.
									SUM	23.76	21.06	2.70	71310.
										(604.3)	(535.1)	(68.3)	(2019.2)

HYDROGRAPH AT STA AT FCP PLAN 1, RTIO 2

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	5.	11.	19.	27.	33.	38.	42.	45.
46.	46.	47.	47.	48.	48.	49.	49.	49.	49.	49.
49.	49.	49.	49.	49.	49.	49.	49.	49.	49.	49.
49.	49.	60.	95.	163.	248.	330.	398.	447.	486.	515.
525.	558.	597.	610.	629.	651.	682.	717.	748.	774.	795.
790.	809.	865.	1081.	1461.	1899.	2108.	2057.	1833.	1532.	1291.
1291.	1130.	1016.	926.	849.	782.	730.	688.	649.	590.	497.
497.	389.	296.	202.	144.	106.	80.	62.	50.	41.	36.
36.	32.	29.	27.	26.	25.	24.	24.	24.	24.	24.
24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.
24.	24.	24.	24.	23.	22.	19.	15.	11.	8.	

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	2198.	891.	297.	238.	35637.
	CMS	60.	25.	7.	7.	1009.
	INCHES		9.53	10.58	10.58	10.58
	MM		242.07	268.80	268.84	268.84
PLAN 2 SAME AS PLAN 1	AC-FT		442.	491.	491.	491.
PLAN 3 SAME AS PLAN 2	THOUS CU M		545.	605.	605.	605.



HYDROGRAPH ROUTING

ROUTE INFLOW HYDROGRAPH THROUGH IMPOUNDMENT

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

CLOSS	CLOSS	AVG	IPES	ISAME	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0

NSTPS	NSTPL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	174.	-1

ELEV	521.10	521.50	521.90	522.30	522.70	522.90	523.30	523.60	524.00	524.90
	526.00	528.00	530.00	532.00						
FLOW	0.00	26.00	74.00	135.00	208.00	491.00	583.00	575.00	663.00	1660.00
	4259.00	12665.00	30097.00	49280.00						
CAPACITY=	0.	174.	218.	272.	320.	379.	560.	794.	1080.	1395.
	2044.									
ELEVATION=	511.	521.	524.	526.	528.	530.	535.	540.	545.	550.
	560.									

CREL	SPWID	COOW	EXPW	FLEVL	COOL	CAREA	EXPL
521.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
523.6	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	1.00	513.60	.50	521.10	550.00

(NO BREACH)

STATION A2, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	3.	5.	6.	8.
10.	11.	13.	15.	16.	18.	19.	21.	22.	24.
25.	26.	28.	30.	32.	33.	35.	36.	37.	38.
39.	40.	41.	45.	52.	66.	89.	120.	157.	199.
374.	491.	499.	509.	519.	531.	644.	558.	574.	595.
617.	639.	663.	921.	1050.	1371.	1709.	2022.	1958.	1727.
1543.	1374.	1220.	1093.	988.	900.	827.	767.	717.	667.
649.	624.	580.	556.	520.	421.	204.	186.	169.	153.
137.	125.	115.	105.	96.	88.	81.	75.	70.	66.
62.	59.	56.	53.	50.	48.	46.	44.	42.	40.
39.	37.	36.	35.	34.	33.	32.	30.	29.	27.

STATION A2 PLAN 1, RATIO 2 CONTINUED (NO BREACH).

STORAGE

174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	175.	175.	175.	176.	176.
177.	177.	179.	178.	179.	179.	179.	180.	180.	180.
181.	181.	181.	182.	182.	182.	182.	183.	183.	183.
183.	183.	183.	184.	185.	187.	190.	193.	197.	201.
204.	206.	207.	209.	210.	211.	213.	215.	217.	220.
222.	224.	227.	230.	235.	241.	248.	251.	250.	248.
240.	241.	239.	236.	234.	232.	230.	229.	228.	227.
226.	223.	219.	215.	210.	205.	202.	200.	198.	197.
195.	194.	193.	192.	191.	190.	189.	188.	188.	187.
186.	186.	185.	185.	185.	184.	184.	184.	183.	183.
183.	183.	183.	182.	182.	182.	182.	182.	181.	181.

STAGE

521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.2	521.2	521.2	521.2
521.2	521.3	521.3	521.3	521.4	521.4	521.4	521.4	521.4	521.5
521.5	521.5	521.5	521.5	521.5	521.6	521.6	521.6	521.6	521.6
521.6	521.6	521.6	521.7	521.7	521.8	522.0	522.2	522.4	522.6
522.8	522.9	523.0	523.0	523.1	523.2	523.3	523.4	523.6	523.7
523.8	523.9	524.0	524.1	524.3	524.6	524.9	525.0	525.0	524.9
524.8	524.6	524.5	524.4	524.3	524.2	524.1	524.1	524.0	524.0
523.9	523.8	523.6	523.4	523.1	522.9	522.7	522.6	522.5	522.4
522.3	522.2	522.2	522.1	522.0	522.0	521.9	521.9	521.9	521.8
521.8	521.8	521.7	521.7	521.7	521.7	521.7	521.6	521.6	521.6
521.6	521.6	521.6	521.6	521.6	521.6	521.5	521.5	521.5	521.5

PEAK OUTFLOW IS 2022. AT TIME 16.33 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2022.	865.	244.	234.	35119.
CMS	57.	24.	7.	7.	994.
INCHES		9.25	10.43	10.43	10.43
MM		234.97	264.93	264.94	264.94
AC-FT		429.	484.	484.	484.
THOUS CU M		529.	597.	597.	597.

STATION A2% PLAN 2% RATIO 2

BEGIN DAM FAILURE AT 15.00 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	3.	5.	6.	8.
10.	11.	13.	15.	16.	18.	19.	21.	22.	24.
26.	26.	29.	30.	32.	33.	35.	36.	37.	38.
39.	40.	41.	45.	52.	66.	88.	120.	157.	199.
370.	491.	609.	509.	519.	531.	544.	558.	574.	595.
701.	877.	1097.	1368.	1709.	2131.	2095.	2091.	2048.	1791.
1602.	1478.	1359.	1250.	1154.	1076.	1008.	954.	904.	856.
808.	760.	683.	618.	556.	499.	447.	402.	362.	328.
297.	271.	248.	227.	210.	194.	180.	167.	156.	146.
137.	129.	123.	115.	109.	103.	98.	94.	89.	85.
82.	78.	75.	72.	70.	67.	65.	62.	59.	57.

STORAGE

174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	175.	175.	175.	176.	176.
177.	177.	178.	178.	178.	179.	179.	180.	180.	180.
181.	181.	181.	182.	182.	182.	182.	183.	183.	183.
183.	183.	183.	184.	185.	187.	190.	193.	197.	201.
204.	206.	207.	208.	210.	211.	213.	215.	217.	220.
222.	222.	220.	216.	213.	210.	208.	208.	207.	203.
199.	195.	190.	185.	181.	177.	173.	169.	166.	162.
158.	154.	149.	143.	137.	132.	126.	121.	117.	113.
109.	106.	102.	100.	97.	95.	92.	90.	88.	87.
85.	83.	82.	81.	80.	78.	77.	76.	75.	75.
74.	73.	72.	72.	71.	70.	70.	69.	68.	68.

STAGE

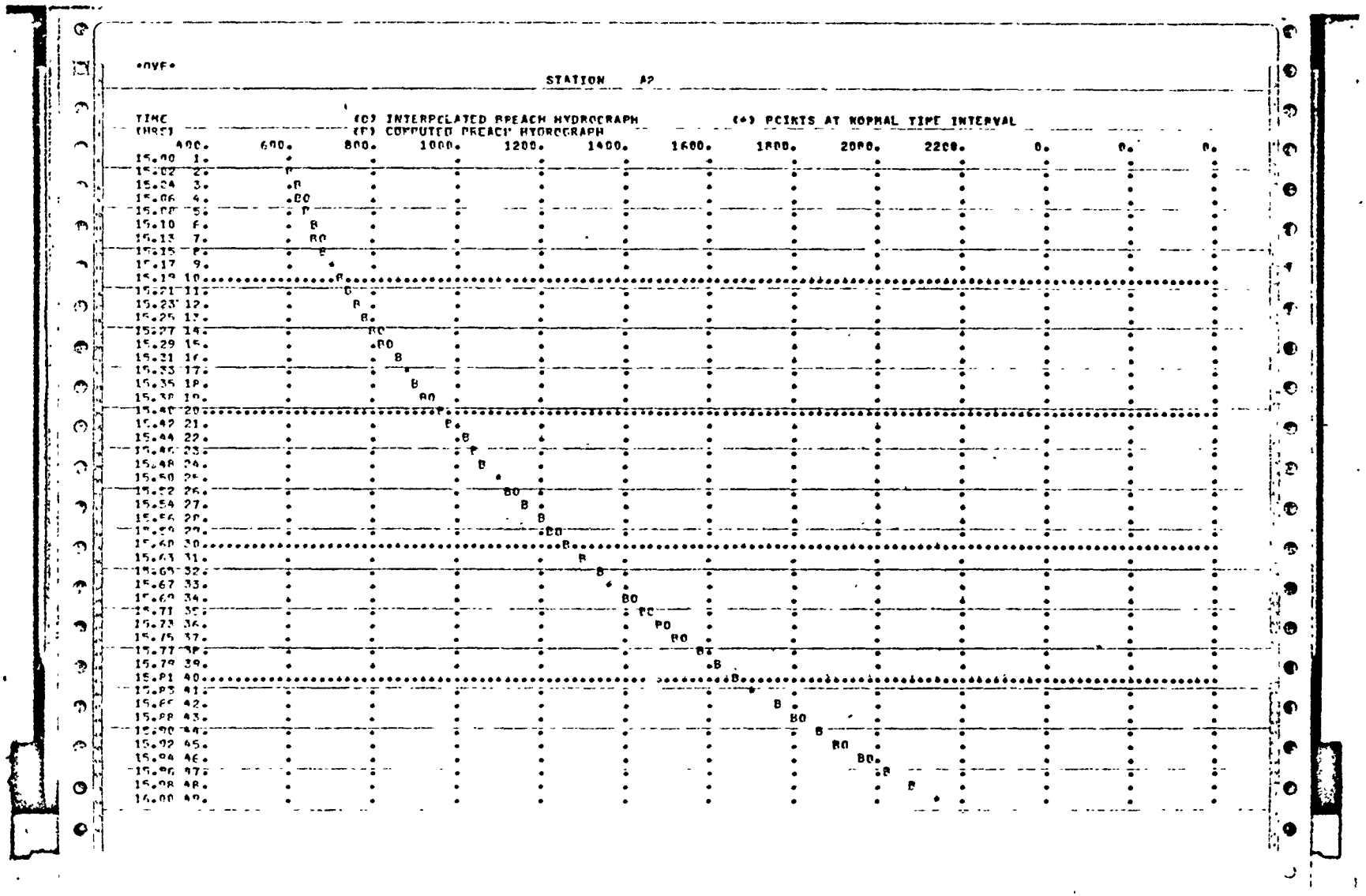
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1	521.1
521.1	521.1	521.1	521.1	521.1	521.1	521.2	521.2	521.2	521.2
521.2	521.3	521.3	521.3	521.4	521.4	521.4	521.4	521.4	521.5
521.5	521.5	521.5	521.5	521.5	521.6	521.6	521.6	521.6	521.6
521.6	521.6	521.6	521.7	521.7	521.8	522.0	522.2	522.4	522.6
522.8	522.9	523.0	523.0	523.1	523.2	523.3	523.4	523.6	523.7
523.8	523.8	523.7	523.6	523.5	523.4	523.1	523.0	522.9	522.8
522.6	522.3	522.0	521.8	521.6	521.3	521.0	520.8	520.6	520.4
520.2	519.9	519.7	519.5	519.3	519.0	518.7	518.4	518.1	517.8	517.6
517.4	517.2	517.0	516.8	516.7	516.5	516.4	516.3	516.2	516.1
516.0	515.9	515.8	515.7	515.7	515.6	515.5	515.5	515.4	515.4
515.3	515.3	515.2	515.2	515.2	515.1	515.1	515.1	515.0	515.0

PEAK OUTFLOW IS 2131. AT TIME 16.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2131.	1019.	302.	289.	43423.
CMS	60.	29.	9.	8.	1230.
INCHES		10.98	12.90	12.90	12.90
MM		278.76	327.58	327.58	327.58
AC-FT		505.	598.	598.	598.
THOUS CU M		623.	738.	738.	738.

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
15.000	0.000	595.		595.		0.	0.	0.
15.021	.021	608.		602.		6.	6.	0.
15.042	.042	622.		613.		9.	15.	0.
15.063	.063	635.		624.		11.	27.	0.
15.083	.083	648.		637.		12.	38.	0.
15.104	.104	661.		651.		10.	49.	0.
15.125	.125	675.		667.		8.	57.	0.
15.146	.146	688.		683.		5.	61.	0.
15.167	.167	701.		701.		0.	61.	0.
15.188	.188	723.		720.		3.	64.	0.
15.208	.208	745.		740.		5.	69.	0.
15.229	.229	767.		761.		6.	76.	0.
15.250	.250	789.		782.		7.	82.	0.
15.271	.271	811.		805.		6.	88.	0.
15.292	.292	833.		828.		5.	93.	0.
15.313	.313	855.		852.		3.	96.	0.
15.333	.333	877.		877.		0.	96.	0.
15.354	.354	904.		902.		2.	98.	0.
15.375	.375	932.		928.		4.	102.	0.
15.396	.396	959.		955.		5.	106.	0.
15.417	.417	987.		982.		5.	111.	0.
15.438	.438	1015.		1010.		4.	116.	0.
15.458	.458	1042.		1039.		4.	119.	0.
15.479	.479	1070.		1068.		2.	121.	0.
15.500	.500	1097.		1097.		-0.	121.	0.
15.521	.521	1131.		1129.		3.	125.	0.
15.542	.542	1165.		1159.		6.	131.	0.
15.563	.563	1199.		1191.		7.	138.	0.
15.583	.583	1233.		1225.		8.	146.	0.
15.604	.604	1266.		1259.		7.	153.	0.
15.625	.625	1300.		1295.		6.	159.	0.
15.646	.646	1334.		1331.		3.	162.	0.
15.667	.667	1368.		1368.		0.	162.	0.
15.688	.688	1411.		1406.		5.	167.	0.
15.708	.708	1453.		1445.		8.	175.	0.
15.729	.729	1496.		1486.		10.	184.	0.
15.750	.750	1539.		1528.		10.	195.	0.
15.771	.771	1581.		1572.		10.	204.	0.
15.792	.792	1624.		1616.		8.	212.	0.
15.813	.812	1666.		1662.		4.	216.	0.
15.833	.833	1709.		1709.		0.	216.	0.
15.854	.854	1762.		1757.		5.	221.	0.
15.875	.875	1815.		1807.		8.	228.	0.
15.896	.896	1867.		1858.		10.	238.	0.
15.917	.917	1920.		1910.		10.	248.	0.
15.938	.937	1973.		1963.		9.	258.	0.
15.958	.958	2025.		2018.		7.	265.	0.
15.979	.979	2078.		2074.		4.	269.	0.
16.000	1.000	131.		2131.		-0.	269.	0.


OVF
STATION A2
TIME (HRS)
(O) INTERPOLATED BREACH HYDROGRAPH
(C) COMPUTED BREACH HYDROGRAPH
(+) POINTS AT NORMAL TIME INTERVAL
400. 600. 800. 1000. 1200. 1400. 1600. 1800. 2000. 2200. 0. 0. 0.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- REACH 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
23	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IPES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	10	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELNVT	ELMAX	FLWTH	SEL
.0700	.0300	.0700	513.6	520.0	830.	.00200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 520.00 280.00 516.00 299.00 515.40 300.00 513.60 315.00 513.60
316.00 515.40 362.00 516.00 588.00 520.00

STORAGE	0.00	.10	.20	.30	.40	.51	.67	1.05	1.68	2.58
	3.75	5.19	6.90	8.89	11.15	13.67	16.47	19.54	22.88	26.49
OUTFLOW	0.00	5.36	16.84	32.76	52.43	75.44	103.71	141.95	194.67	267.09
	363.32	487.14	642.09	831.48	1058.45	1326.03	1637.10	1994.48	2400.87	2858.90
STAGE	513.60	513.94	514.27	514.61	514.95	515.28	515.62	515.96	516.29	516.63
	516.97	517.31	517.64	517.98	518.32	518.65	518.99	519.33	519.66	520.00
FLOW	0.00	5.36	16.84	32.76	52.43	75.44	103.71	141.95	194.67	267.09
	363.32	487.14	642.09	831.48	1058.45	1326.03	1637.10	1994.48	2400.87	2858.90

STATION AT 6 PLAN 1. RTIO 2 (NO BREACH)

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	3.	4.	6.
8.	10.	12.	14.	15.	17.	19.	20.	22.	23.
24.	26.	27.	29.	31.	33.	34.	35.	37.	38.
39.	40.	41.	43.	49.	61.	80.	106.	133.	167.
253.	384.	467.	495.	510.	522.	534.	547.	562.	579.
600.	622.	645.	722.	893.	1156.	1484.	1820.	1971.	1857.
1660.	1485.	1322.	1183.	1063.	966.	882.	813.	757.	706.
660.	643.	615.	583.	548.	489.	358.	241.	196.	170.
150.	136.	123.	112.	102.	91.	84.	77.	72.	67.
63.	60.	57.	54.	51.	49.	46.	44.	43.	41.
39.	38.	37.	36.	34.	33.	32.	31.	30.	28.

STATION A3, PLAN 1, RATIO 2 CONTINUED (NO BREACH)

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
3.	4.	5.	5.	5.	6.	6.	6.	6.	6.
6.	7.	7.	8.	10.	12.	15.	18.	19.	18.
17.	15.	14.	12.	11.	10.	9.	9.	8.	8.
7.	7.	7.	6.	6.	5.	4.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6
513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.7
513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7
513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7
513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.8	513.9	514.0
514.0	514.1	514.1	514.2	514.2	514.3	514.3	514.3	514.4	514.4
514.4	514.5	514.5	514.5	514.6	514.6	514.6	514.7	514.7	514.7
514.7	514.7	514.7	514.8	514.9	515.1	515.3	515.6	515.9	516.1
516.6	517.0	517.2	517.3	517.4	517.4	517.4	517.4	517.5	517.5
517.5	517.6	517.6	517.8	518.1	518.4	518.8	519.2	519.3	519.2
519.0	518.8	518.6	518.5	518.3	518.2	518.1	517.9	517.8	517.8
518.0	518.8	518.6	518.5	518.3	518.2	518.1	517.9	517.8	517.8
517.7	517.6	517.6	517.5	517.4	517.3	516.9	516.5	516.3	516.1
516.0	515.9	515.8	515.7	515.6	515.5	515.4	515.3	515.2	515.2
515.1	515.1	515.0	515.0	514.9	514.9	514.8	514.8	514.8	514.7
514.7	514.7	514.7	514.7	514.6	514.6	514.6	514.6	514.5	514.5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1971.	863.	244.	234.	35099.
CMS	56.	24.	7.	7.	994.
INCHES		9.22	10.42	10.42	10.42
"P"		234.27	264.78	264.79	264.79
AC-FT		428.	483.	483.	483.
THOUS CU M		528.	596.	596.	596.

MAXIMUM STAGE= 519.3

MAXIMUM STORAGE = 19.

STATION AS-6 PLAN 2S FTIO 2 (BREACH)

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	3.	4.	6.
8.	10.	12.	14.	15.	17.	19.	20.	22.	23.
24.	26.	27.	29.	31.	33.	34.	35.	37.	38.
39.	40.	41.	43.	49.	61.	80.	106.	133.	167.
253.	384.	477.	495.	510.	522.	534.	547.	562.	579.
632.	756.	1254.	1184.	1487.	1668.	2048.	2093.	2071.	1934.
1723.	1562.	1483.	1322.	1221.	1131.	1056.	994.	941.	891.
841.	788.	738.	667.	605.	545.	490.	441.	397.	358.
325.	295.	269.	241.	227.	209.	193.	179.	166.	155.
145.	136.	127.	120.	113.	107.	101.	95.	91.	87.
83.	80.	76.	73.	71.	68.	65.	63.	60.	58.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
2.	4.	5.	5.	5.	6.	6.	6.	6.	6.
7.	8.	11.	12.	15.	18.	20.	20.	20.	19.
17.	16.	15.	14.	13.	12.	11.	11.	10.	9.
9.	8.	8.	7.	6.	6.	5.	5.	4.	4.
3.	3.	3.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.

STAGE

513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6
513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.6	513.7
513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7
513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.7
513.7	513.7	513.7	513.7	513.7	513.7	513.7	513.8	513.9	514.0
514.0	514.1	514.1	514.2	514.2	514.3	514.3	514.3	514.4	514.4
514.4	514.5	514.5	514.5	514.6	514.6	514.6	514.7	514.7	514.7
514.7	514.7	514.7	514.8	514.9	515.1	515.3	515.6	515.9	516.1
516.6	517.0	517.2	517.3	517.4	517.4	517.4	517.4	517.5	517.5
517.6	517.8	518.1	518.2	518.2	519.2	519.4	519.4	519.4	519.3
519.1	518.9	518.8	518.6	518.5	518.4	518.3	518.2	518.1	518.1
518.0	517.9	517.8	517.7	517.6	517.4	517.3	517.2	517.1	517.0
516.8	516.7	516.6	516.5	516.4	516.4	516.3	516.2	516.1	516.0
516.0	515.9	515.8	515.8	515.7	515.7	515.6	515.5	515.5	515.4
515.4	515.3	515.3	515.3	515.2	515.2	515.1	515.1	515.1	515.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2093.	1017.	301.	289.	83392.
CMS	59.	29.	9.	8.	1229.
INCHES		10.88	12.89	12.89	12.89
PF		276.33	327.34	327.35	327.35
AC-FT		505.	598.	598.	598.
THOUS CU M		622.	737.	737.	737.

MAXIMUM STORAGE = 20.

MAXIMUM STAGE IS 519.4

HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- REACH 2

ISTAQ	ICOPP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A4	1	0	0	0	0	1	0	0

ALL FLAPS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IPES	ISAME	ICPT	IPPP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.0700	.0300	.0700	501.0	510.0	16004	.00750

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 510.00 92.00 504.00 112.00 502.00 122.00 501.00 132.00 501.00
139.00 502.00 188.00 504.00 232.00 510.00

STORAGE	0.00	.24	.63	1.21	2.07	3.22	4.66	6.35	8.24	10.32
	12.58	15.03	17.66	20.47	23.49	26.69	30.07	33.64	37.40	41.34
OUTFLOW	0.00	14.65	55.33	139.00	263.03	430.35	644.96	915.24	1240.72	1619.72
	2053.38	2543.09	3090.38	3696.88	4364.24	5094.17	5888.37	6748.54	7676.40	8673.66
STAGE	501.00	501.47	501.95	502.42	502.89	503.37	503.84	504.32	504.79	505.26
	505.74	506.21	506.68	507.16	507.63	508.11	508.58	509.05	509.53	510.00
FLOW	0.00	14.65	55.33	139.00	263.03	430.35	644.96	915.24	1240.72	1619.72
	2053.38	2543.09	3090.38	3696.88	4364.24	5094.17	5888.37	6748.54	7676.40	8673.66

STATION A4, PLAN 1, RTIO 2 (NO BREACH)

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	3.	4.
6.	8.	10.	12.	13.	15.	17.	19.	21.	22.
23.	25.	26.	28.	30.	31.	33.	35.	36.	37.
38.	39.	40.	42.	45.	53.	70.	93.	115.	150.
210.	318.	426.	481.	502.	516.	528.	541.	555.	570.
590.	611.	633.	695.	813.	1039.	1347.	1680.	1924.	1913.
1737.	1551.	1366.	1237.	1113.	1006.	917.	844.	782.	729.
685.	654.	628.	598.	565.	518.	422.	299.	218.	183.
161.	144.	130.	118.	107.	97.	88.	81.	74.	69.
65.	62.	58.	55.	53.	50.	48.	46.	44.	42.
40.	39.	38.	36.	35.	34.	33.	32.	31.	29.

STATION AA, PLAN 1, RATIO 2, CONTINUED (NO BREACH)

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
2.	2.	3.	4.	4.	4.	4.	4.	4.	4.
4.	4.	5.	5.	6.	7.	9.	11.	12.	12.
11.	10.	9.	8.	7.	7.	6.	6.	6.	5.
5.	5.	5.	4.	4.	4.	3.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.1	501.1	501.1	501.1
501.2	501.3	501.3	501.4	501.4	501.5	501.5	501.5	501.5	501.6
501.6	501.6	501.6	501.6	501.6	501.7	501.7	501.7	501.7	501.7
501.7	501.8	501.8	501.8	501.8	501.9	502.0	502.2	502.3	502.5
502.7	503.1	503.4	503.5	503.5	503.6	503.6	503.6	503.6	503.7
503.7	503.8	503.8	503.9	504.1	504.5	504.9	505.3	505.6	505.6
505.4	505.2	505.0	504.8	504.6	504.4	504.3	504.2	504.1	504.0
503.9	503.9	503.8	503.7	503.7	503.6	503.3	503.0	502.7	502.6
502.5	502.4	502.4	502.3	502.2	502.2	502.1	502.1	502.1	502.0
502.0	502.0	502.0	501.9	501.9	501.9	501.9	501.8	501.8	501.8
501.8	501.8	501.7	501.7	501.7	501.7	501.7	501.7	501.7	501.6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1924.	862.	244.	234.	35072.
CMS	54.	24.	7.	7.	993.
INCHES		9.22	10.42	10.42	10.42
MM		234.20	264.58	264.58	264.58
AC-FT		428.	483.	483.	483.
THOUS CU M		527.	596.	596.	596.

MAXIMUM STAGE IS 505.6
MAXIMUM STORAGE = 12.

STATION 44, PLAN 2, RTIO 2

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	3.	4.
6.	8.	10.	12.	13.	15.	17.	19.	21.	22.
23.	25.	26.	28.	30.	31.	33.	35.	36.	37.
38.	39.	40.	42.	45.	53.	70.	93.	119.	150.
210.	318.	426.	481.	502.	516.	528.	541.	555.	571.
606.	697.	857.	1079.	1361.	1716.	2014.	2102.	2079.	1992.
1806.	1620.	1486.	1368.	1260.	1168.	1087.	1020.	963.	912.
864.	812.	757.	696.	634.	574.	517.	465.	419.	378.
342.	310.	282.	258.	237.	218.	201.	186.	173.	161.
150.	140.	131.	123.	117.	110.	104.	98.	92.	89.
84.	81.	78.	75.	72.	69.	67.	64.	62.	59.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
2.	2.	3.	4.	4.	4.	4.	4.	4.	4.
4.	5.	6.	7.	9.	11.	12.	13.	13.	12.
11.	10.	10.	9.	8.	8.	7.	7.	7.	6.
6.	6.	5.	5.	5.	4.	4.	3.	3.	3.
3.	2.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

STAGE

501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0	501.0
501.0	501.0	501.0	501.0	501.0	501.0	501.1	501.1	501.1	501.1
501.2	501.3	501.3	501.4	501.4	501.5	501.5	501.5	501.5	501.6
501.6	501.6	501.6	501.6	501.6	501.7	501.7	501.7	501.7	501.7
501.7	501.8	501.8	501.8	501.8	501.9	502.0	502.2	502.3	502.5
502.7	503.1	503.4	503.5	503.5	503.6	503.6	503.6	503.6	503.7
503.8	503.9	504.2	504.6	504.9	505.4	505.7	505.8	505.8	505.7
505.5	505.3	505.1	504.9	504.8	504.7	504.6	504.5	504.4	504.3
504.2	504.1	504.0	503.9	503.8	503.7	503.6	503.4	503.3	503.2
503.1	503.0	502.9	502.9	502.8	502.7	502.7	502.6	502.5	502.5
502.5	502.4	502.4	502.3	502.3	502.2	502.2	502.2	502.2	502.1
502.1	502.1	502.1	502.1	502.0	502.0	502.0	502.0	502.0	502.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2102.	1017.	301.	289.	43344.
CMS	60.	29.	9.	8.	1227.
INCHES		10.88	12.87	12.87	12.87
MM		276.31	326.99	326.99	326.99
AC-FT		504.	597.	597.	597.
THOUS CU M		622.	736.	736.	736.

MAXIMUM STORAGE = 13.

MAXIMUM STAGE IS 505.8

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .50	RATIO 3 1.00
HYDROGRAPH AT	A1	.87	1	843.	2108.	4216.
	(	2.25)	(	23.88)(	59.69)(	119.38)(
			2	843.	2108.	4216.
			(	23.88)(	59.69)(	119.38)(
			3	843.	2108.	4216.
			(	23.88)(	59.69)(	119.38)(
ROUTED TO	A2	.87	1	594.	2022.	4118.
	(	2.25)	(	16.83)(	57.26)(	116.62)(
			2	1232.	2131.	3866.
			(	34.88)(	60.38)(	110.04)(
			3	900.	2178.	3906.
			(	25.48)(	61.68)(	110.61)(
ROUTED TO	A3	.87	1	591.	1971.	4019.
	(	2.25)	(	16.72)(	55.82)(	113.80)(
			2	1123.	2093.	3863.
			(	31.80)(	59.26)(	109.39)(
			3	847.	2154.	3883.
			(	23.98)(	61.00)(	109.97)(
ROUTED TO	A4	.87	1	588.	1924.	4026.
	(	2.25)	(	16.66)(	54.48)(	114.01)(
			2	1124.	2102.	3799.
			(	31.83)(	59.52)(	107.56)(
			3	849.	2138.	3830.
			(	23.93)(	60.54)(	108.45)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... WITHOUT BREACH

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	521.10	521.10	523.60
STORAGE	174.	174.	218.
OUTFLOW	0.	0.	579.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	523.67	.07	220.	594.	.50	16.67	0.00
.50	525.05	1.45	251.	2022.	4.00	16.33	0.00
1.00	525.94	2.34	271.	4118.	6.00	16.33	0.00

PLAN 2 ..... WITH BREACH

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	521.10	521.10	523.60
STORAGE	174.	174.	218.
OUTFLOW	0.	0.	579.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	523.66	.06	219.	1232.	.44	17.50	16.50
.50	523.78	.18	222.	2131.	.75	16.00	15.00
1.00	524.08	1.28	247.	3886.	2.38	14.50	13.50

PLAN 1 STATION A3 WITHOUT BREACH

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	[illegible]	517.5	16.83
.50	1971.	519.3	16.50
1.00	4019.	520.9	16.50

PLAN 2 STATION A3 WITH BREACH

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1123.	518.4	17.67
.50	2093.	519.4	16.33
1.00	3963.	520.7	16.50

PLAN 1 STATION A4 WITHOUT BREACH

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	586.	503.7	17.00
.50	1924.	505.6	16.50
1.00	4026.	507.4	16.50

PLAN 2 STATION A4 WITH BREACH

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1124.	504.6	17.67
.50	2102.	505.6	16.33
1.00	3799.	507.2	16.50

APPENDIX 5

REFERENCES

ROCK RIDGE LAKE DAM

APPENDIX 5

REFERENCES

ROCK RIDGE LAKE DAM

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